Iron and Steel ENGINEER

ENGINEERING SERVICE TO THE IRON AND STEEL INDUSTRY SINCE 1907

10 EMPIRE BUILDING | JUNE, 1945 | PITTSBURGH, PA.

HNOLOGY DEPT

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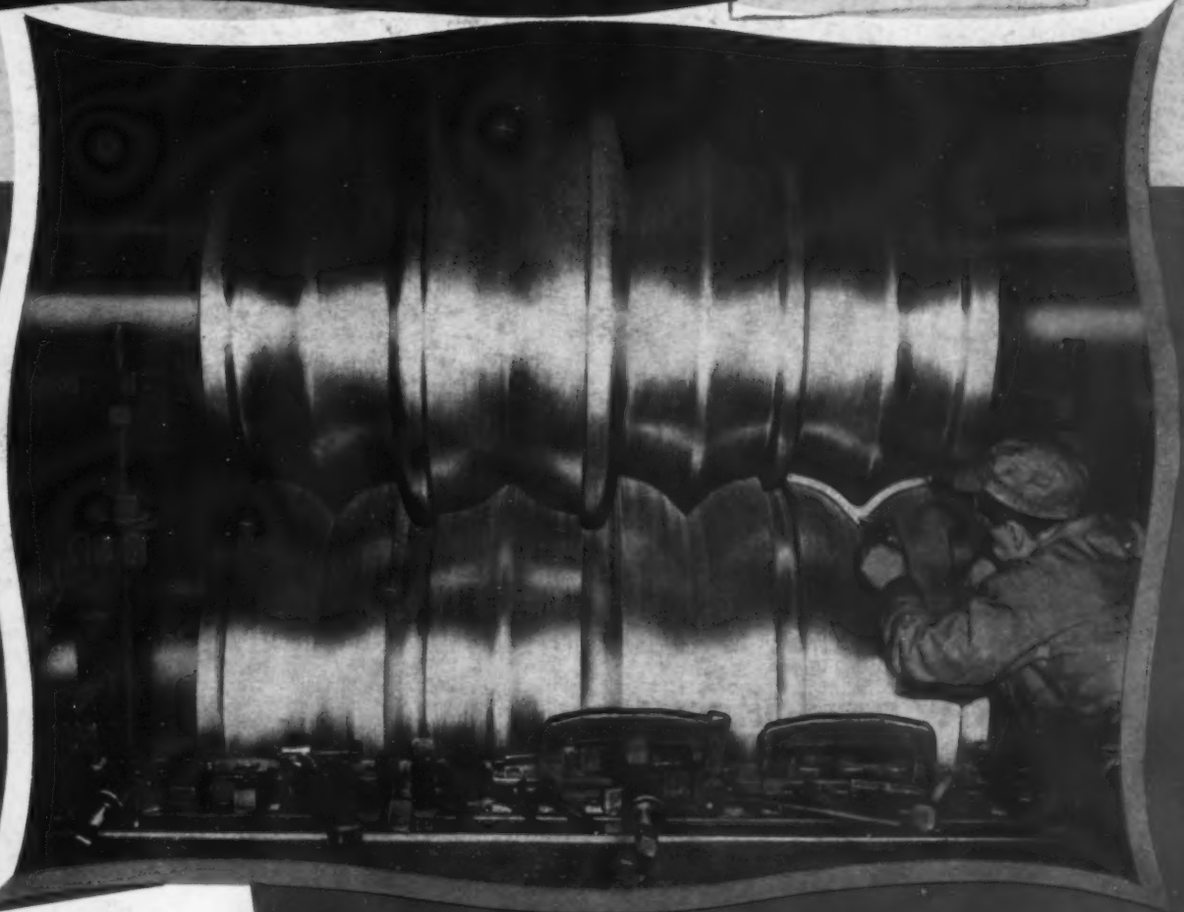
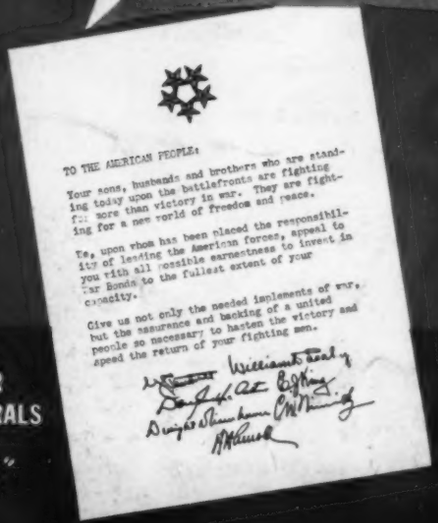
DETROIT

MESTA ROLLS




TO THE AMERICAN PEOPLE:
Your sons, husbands and brothers who are standing today upon the battlefronts are fighting for more than victory in war. They are fighting for a new world of freedom and peace.
We, upon whom has been placed the responsibility of leading the American forces, appeal to you with all possible earnestness to invest in War Bonds to the fullest extent of your capacity.
Give us not only the needed implements of war, but the assurance and backing of a united people so necessary to hasten the victory and speed the return of your fighting men.

MESTA SPECIAL ALLOY STEEL 29 INCH STRUCTURAL MILL

INTERMEDIATE ROLLS FOR ROLLING 8" x 8" ANGLES

"FROM OUR STAR GENERALS AND ADMIRALS"

MESTA MACHINE CO.
PITTSBURGH, PA.

ARMY E NAVY

A New Chapter in CRANE PERFORMANCE...

NOW...You Can Get DC Performance on AC Cranes

Thanks to Cutler-Hammer engineers, modern cranes are operating on AC and getting DC performance. No longer must factories install expensive equipment for generating direct current. No longer must these plants install cranes equipped with mechanical load brakes.

With the new Cutler-Hammer AC Crane Control, complete load-control is at your finger-tips at all times.... Five definite and selective speeds of hoisting and lowering; full dynamic braking; timed load acceleration and deceleration that fits the type of operation; accurate jogging that safely places even the most unwieldy load "*on spot*"... all with alternating current that responds to the touch at the C-H Master Control Switch.

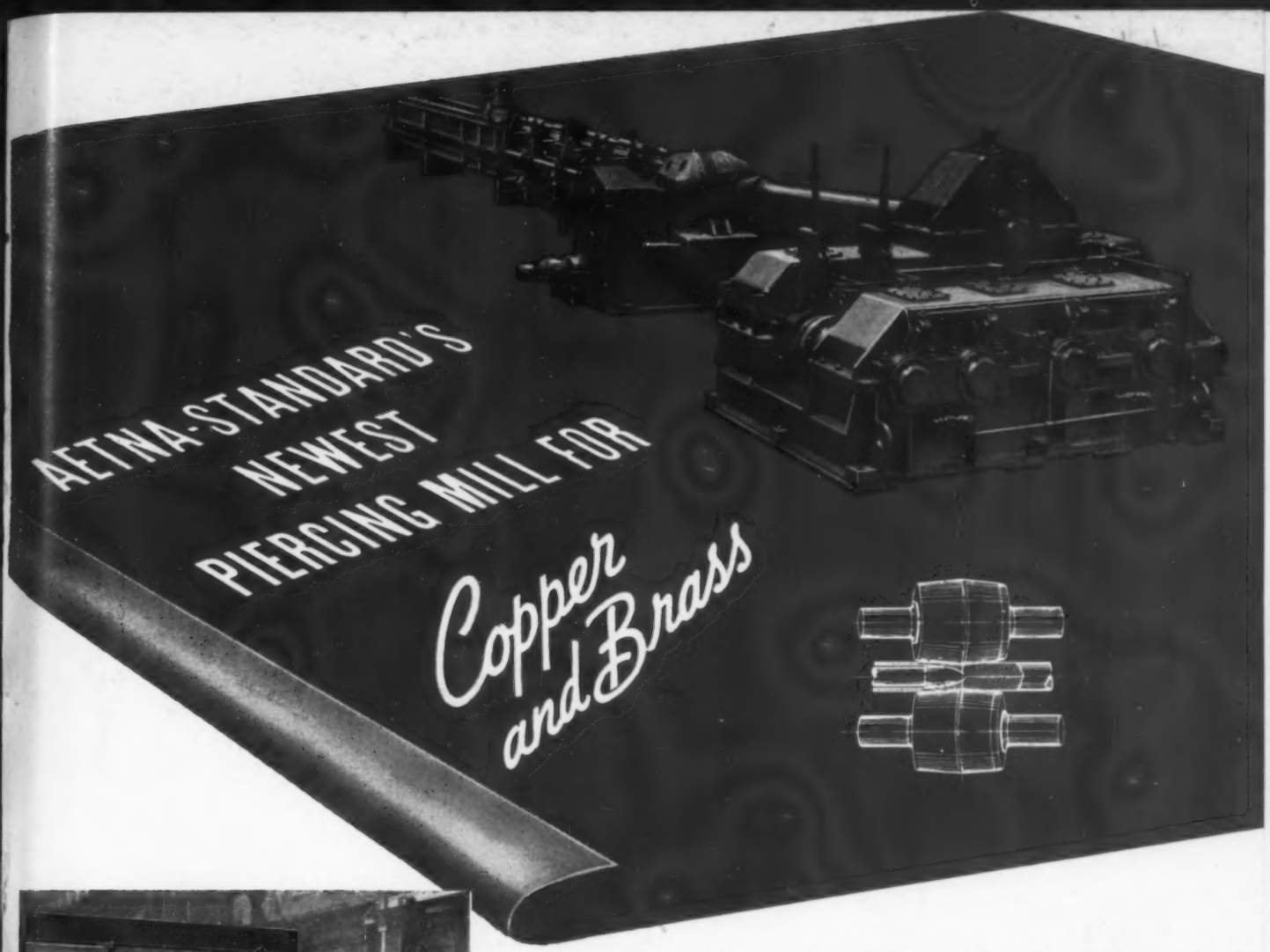
This new Cutler-Hammer AC Crane Control can be used with any standard slip ring crane motor and is available in manual drum type and magnetic types. Insist on this unique engineering development for your next crane installation. Write or wire TODAY for full information. CUTLER-HAMMER, Inc., 1269 St. Paul Avenue, Milwaukee 1, Wisconsin. *Associate:* Canadian Cutler-Hammer, Ltd., Toronto, Ont.

Engineering Excellence finds its Greatest Reward in the Respect and Confidence of those it Serves

CUTLER-HAMMER

MOTOR CONTROL

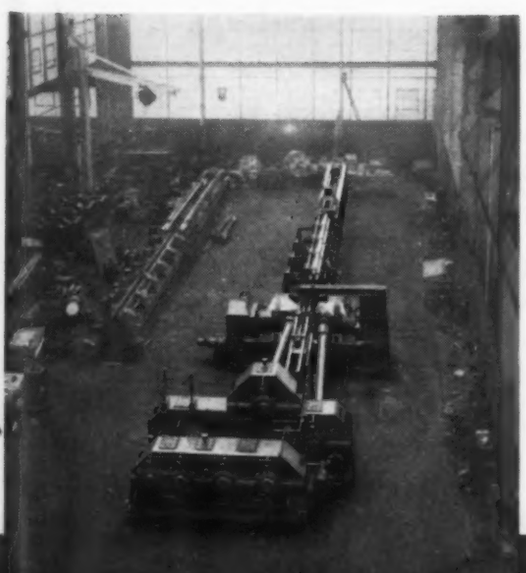
C-H



This Aetna mill for piercing copper or brass tubing 3″ to 10″ O.D. eliminates all manual operation.

One operator, in the pulpit, has complete push-button control of each billet from the furnace, through the mill and until the finished tubing moves off the outlet table.

Aetna-Standard is the only producer of piercing mills. However, we also manufacture, for the non-ferrous industries, much other production machinery, such as cold-drawing equipment, pointers, and straightening presses.



THE FEATURES OF AETNA'S ONE-MAN PIERCING MILL

A Spacing of mandrel bar supporting housings is automatic and synchronized with mandrel bar travel.

B C-Clamp design of main mill housing eliminates overhead cap, permitting unobstructed view and quick change of guide roller, also facilitates changing of main rolls.

C To meet varying billet size and types of materials, feed angles of rolls can be changed easily.

D A two-speed drive, off one motor speed, enables operator to select either a slow or a fast speed, depending upon requirements of material and diameter, one of the most important features.

THE AETNA-STANDARD
ENGINEERING COMPANY
YOUNGSTOWN, OHIO

DESIGNERS AND BUILDERS to the Steel, Non-Ferrous and Chemical Industries.

ASSOCIATED COMPANIES:
HEAD, WRIGHTSON & COMPANY, LIMITED, THORNABY-ON-TEES, ENGLAND
JOHN INGLIS COMPANY, LIMITED, TORONTO, ONTARIO, CANADA

ANOTHER AETNA-STANDARD PRODUCT

United

Plate and Squaring Shears

7 SIZE SERIES

For Mild Steel Up to 1¾" and Lengths to 13 Feet

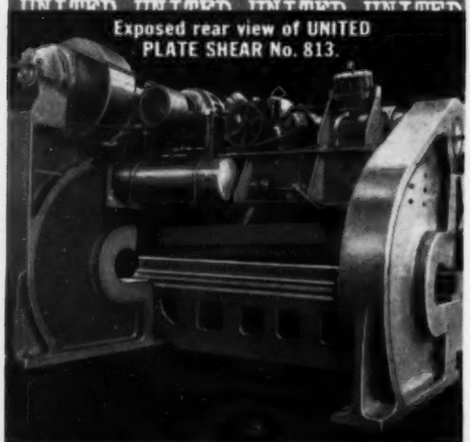
UNITED PLATE SHEAR No. 813, knife pressure 640,000 lbs., for 1 9/16 inch mild steel 156 inches wide.

Illustrated is UNITED PLATE SHEAR No. 813, with a rate knife pressure of 640,000 pounds, capable of shearing 1 9/16 inch mild steel plate 156 inches wide.

Drive is through cone worm gears and V-belts, a greatly improved method of driving a shear. Plate holddown, or gags, air operated from a self-contained system, are arranged to afford operators the best possible vision when lining up plates for either cutting or slitting. Top knife head is air balanced from an independent, self-contained system providing constant balance at all times. Design of the bottom knife head provides means for easily catching plates permitting them to be moved or inched along as required.

This shear has recently been redesigned to improve its operating characteristics and greatly reduce its overall size. It is typical of the general design of our complete line of PLATE and SQUARING SHEARS. Rugged, simple construction, quiet, easy operation and low maintenance are notable features.

Write for detailed specifications. Our engineers will gladly recommend the right shear for your individual requirement.



Exposed rear view of UNITED PLATE SHEAR No. 813.

Reg. T. M.

United Engineering and Foundry Co.

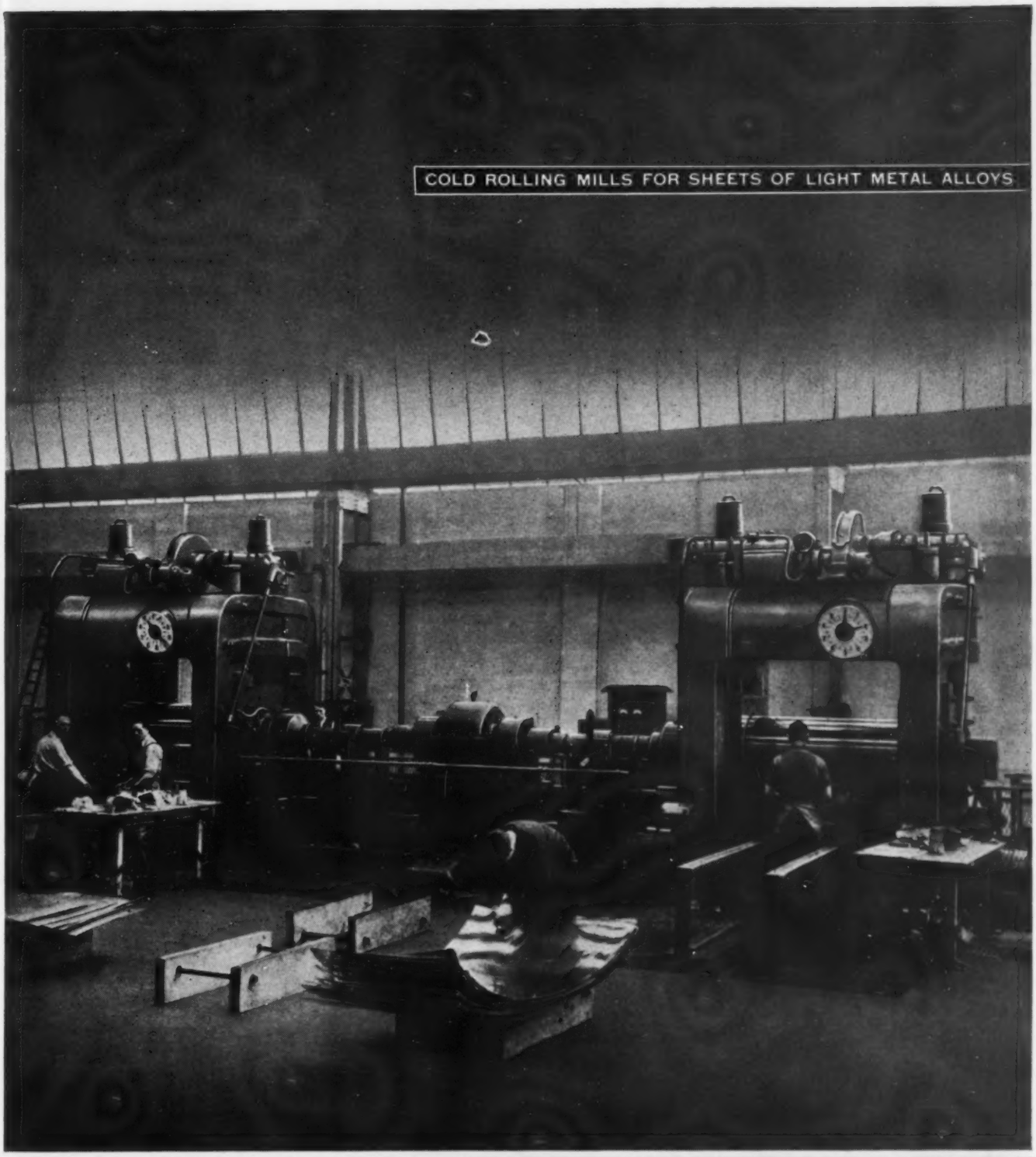
PITTSBURGH, PENNSYLVANIA

Plants at PITTSBURGH · VANDERGRIFT · NEW CASTLE · YOUNGSTOWN · CANTON

Subsidiary: Adamson United Company, Akron, Ohio

Affiliates: Davy and United Engineering Company, Ltd., Sheffield, England
Dominion Engineering Works, Ltd., Montreal, P. Q. Canada

***The World's Largest Designers and Makers of Rolls and Rolling Mill Equipment**



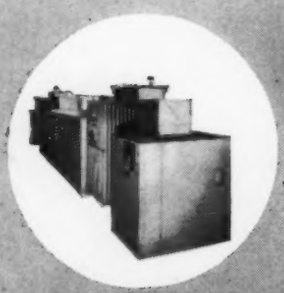
HYDROPRESS · INC.

ENGINEERS CONTRACTORS

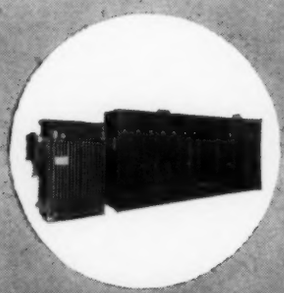
HYDRAULIC PRESSES · ROLLING MILLS
STRETCHERS · PUMPS · ACCUMULATORS

570 LEXINGTON AVENUE · NEW YORK · N. Y.

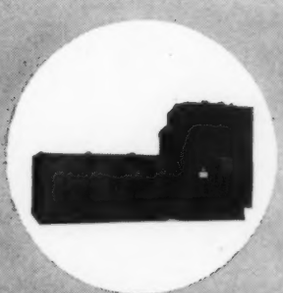
NO MORE *hardening*



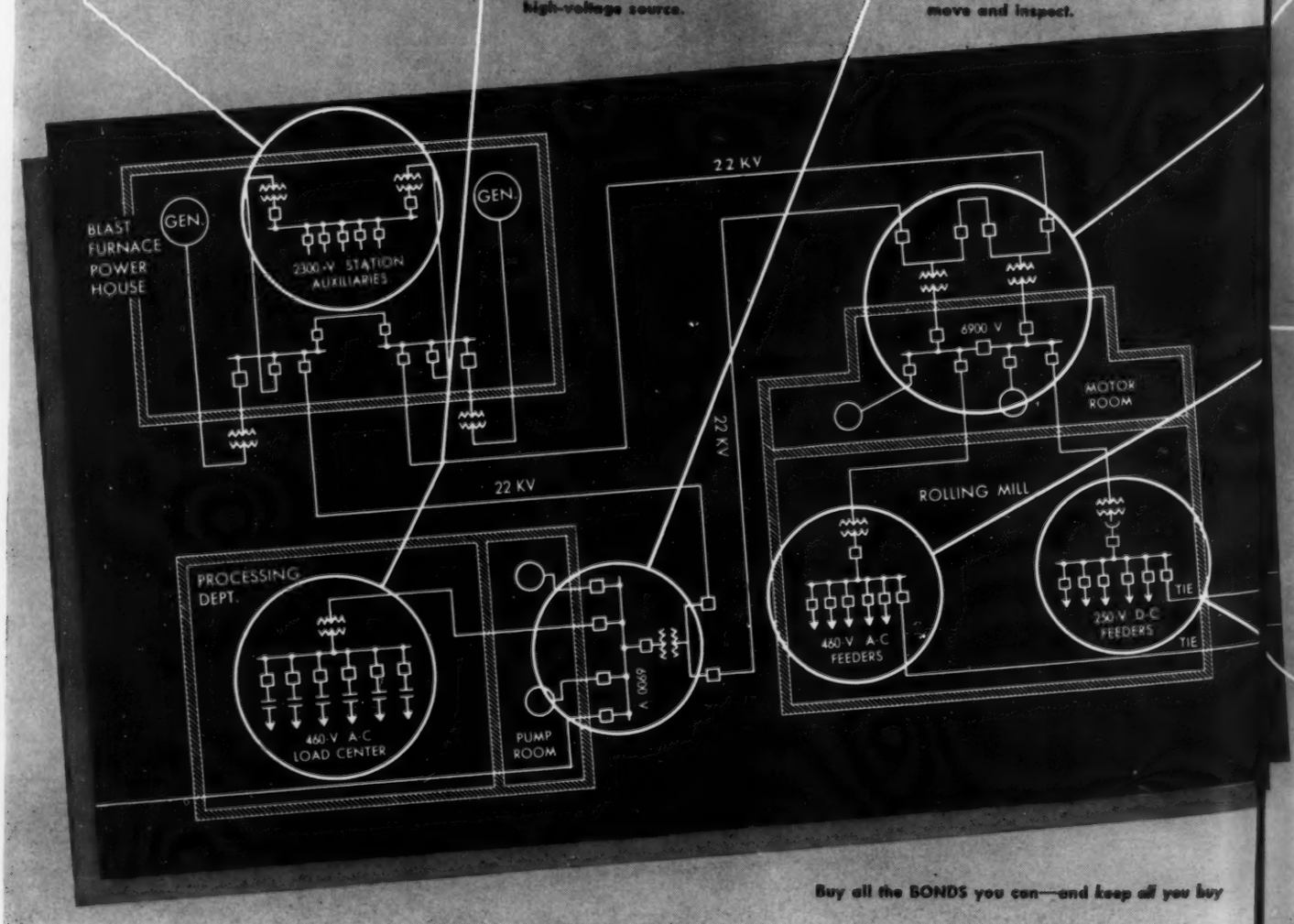
MASTER UNIT SUBSTATION— double-ended type for use where continuity is especially important.



CONTROL-CENTER UNIT— for centralized control of low-voltage motor circuits served directly from high-voltage source.



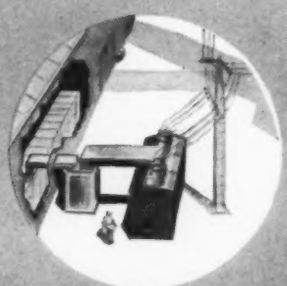
MASTER UNIT SUBSTATION— outdoor type. Vertical-lift, interchangeable breakers are easy to remove and inspect.



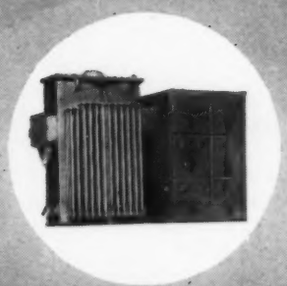
Buy all the BONDS you can—and *keep all you buy*

OF POWER ARTERIES

THESE STANDARD LOAD-CENTER UNITS KEEP STEEL-MILL POWER DISTRIBUTION IN STEP WITH CHANGING NEEDS



UNIT SUBSTATION "POWER ISLAND"—Type FH breakers protect 22-kv loop; make industrial high-voltage distribution practical and economical.



INDOOR UNIT SUBSTATION—compact "go-anywhere" unit, with draw-out air breakers for use at load centers (100 to 2000 kva).

D-C UNIT SUBSTATION—for converting high-voltage a-c to low-voltage d-c at utilization point.

Your distribution equipment need not be a limiting factor in power-supply flexibility—tending to "freeze" your operations to a fixed and obsolete layout.

Expansion, rearrangement, and modernization are all simplified for plants which have standard G-E unit substations and switchgear throughout their load-center power-distribution systems.

Like building blocks, the metal-clad switchgear, Pyranol* or dry-type transformers, and other elements that make up G-E unit substations can be assembled in hundreds of standard arrangements. Because of this versatility, they make it easy to meet the various combinations of requirements in your power-system plans. They make it easy to distribute power at a copper-saving and cost-saving *high* voltage, and then step it down to effective utilization voltage at the center of each load area. They facilitate the use of circuit arrangements which safeguard continuity: network, primary-selective, and secondary-selective systems. They permit highly economical cable runs where both high voltage and low voltage are being utilized in the same area.

Less Manpower Needed for Changes

Units are easily relocated, and no rewiring except the circuit connections is required. Additions to a load-center system can be made step by step to handle new loads without upsetting the system plan, or without interrupting production. Installed costs are fully predictable.

G-E application engineers can supply the facts and figures you want on the use of "packaged" power-distribution equipment for steel mills of any size or type. Just call your local G-E representative. *General Electric Co., Schenectady 5, N. Y.*

*Trade-mark Reg. U.S. Pat. Off.

LOAD-CENTER POWER DISTRIBUTION SYSTEMS

GENERAL ELECTRIC

302-37-5900

"Your helpful technical assistance saved us considerable expense and prevented a serious delay"

. . . a comment from a manufacturer regarding Airco Engineering Service

MANY such letters in our files reflect a fact known by users of Airco oxygen — individualized, technical aid is an extremely valuable part of Airco's *complete* oxygen service.

Experienced Airco engineering representatives are "on call" throughout the nation. Their job is to aid Airco customers make most effective use of Airco oxygen.

Write for an interesting free booklet "Oxygen — Indispensable Servant of Industry". Address Department IS at the New York office.

AIR REDUCTION AIRCO

General Offices: 60 E. 42nd St., NEW YORK 17, N. Y.
In Texas: Magnolia Airco Gas Products Co. • General Offices: Houston 1, Texas
Offices in all Principal Cities

AIRCO OXYGEN GUARANTEED 99.5% PURE IN THE CYLINDER

WILL YOUR PLANT NEED MORE Lifting Power?

This 270-ton giant Alliance gantry crane, recently installed on the Joe Wheeler Dam of TVA, combines unusual construction with beauty of design. The span is 90' . . . the short leg measures 16' and the long leg is 44' in length.

You know us as the **"world's largest builders of the world's largest cranes,"** such as the 270-ton gantry crane shown here . . . or as the originator of new ideas in cranes, such as the multiple range tongs for soaking pit cranes recently announced by us.

But do you know we are working with many customers on the altering of existing lifting facilities, as required by the revamping of a plant for new production?

You may want to relocate or step up the capacity of your present cranes. Alliance specialists can help you with this conversion by increasing or decreasing spans, changing hoist arrangements, or in other ways.

Check with The Alliance Machine Company for cost-saving recommendations on new cranes or reconversion of old cranes.

Alliance

THE ALLIANCE MACHINE COMPANY • ALLIANCE, OHIO

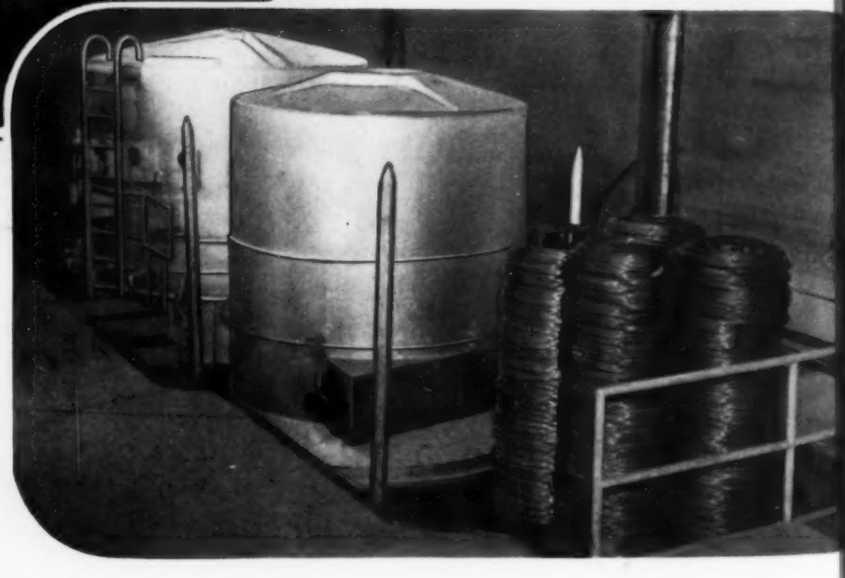
PITTSBURGH OFFICE : 1622 OLIVER BUILDING

This WILSON BELL TYPE *Furnace*

SETS A NEW RECORD IN WIRE ANNEALING at WILSON STEEL WIRE COMPANY

THIS Wilson radiant tube fired wire annealing unit has a base size of 7' diameter and a piling height of 84". Charges average 18,000 lbs. and furnace time is only 8 hours. New low fuel rates of 1,000,000 B. T. U. per net ton of wire have been established.

Note dual pressure burner combustion control equipment all mounted on furnace.



Note charge — four stacks of 22" block wire.

Also forced cooler to speed up cooling cycle.

ENGINEERED AND CONSTRUCTED BY THE

Lee Wilson ENGINEERING Co., Inc.

20005 West Lake Road CLEVELAND, OHIO

Telephone ACademy 4670

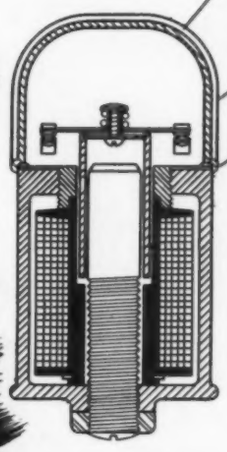
The Wilson Annealing Unit is covered by Patents Nos. 1,952,402. 2,069,477. 2,078,356. 2,081,612. 2,089,843. and other patents pending.

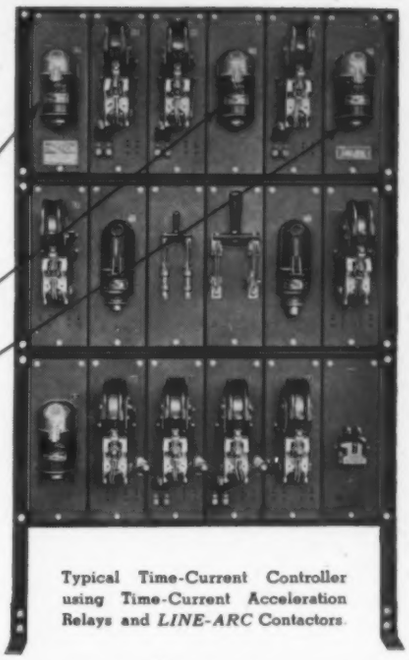
INDUSTRIAL FURNACES • RADIANT TUBE HEATING • HEAT TREATING PROCESSES

EC&M

TIME-CURRENT CONTROL *Gives* Load-Controlled ACCELERATION!

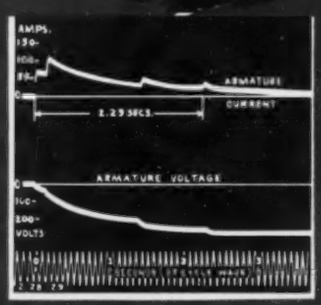
Here's the **PROOF** *of Automatic Proportioning*

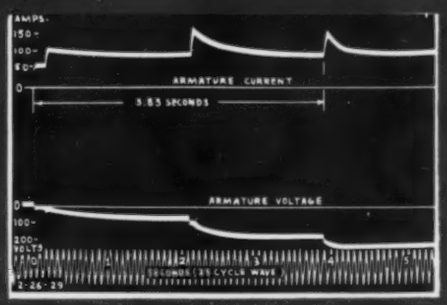


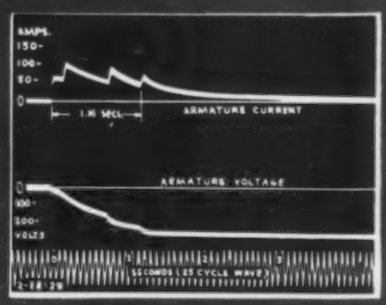


Typical Time-Current Controller using Time-Current Acceleration Relays and *LINE-ARC* Contactors.

-MANUALLY ADJUSTABLE, TOO . . .







The EC&M Time-Current Control automatically proportions the time-per-step according to the load, accelerating the motor in the shortest, safe time.

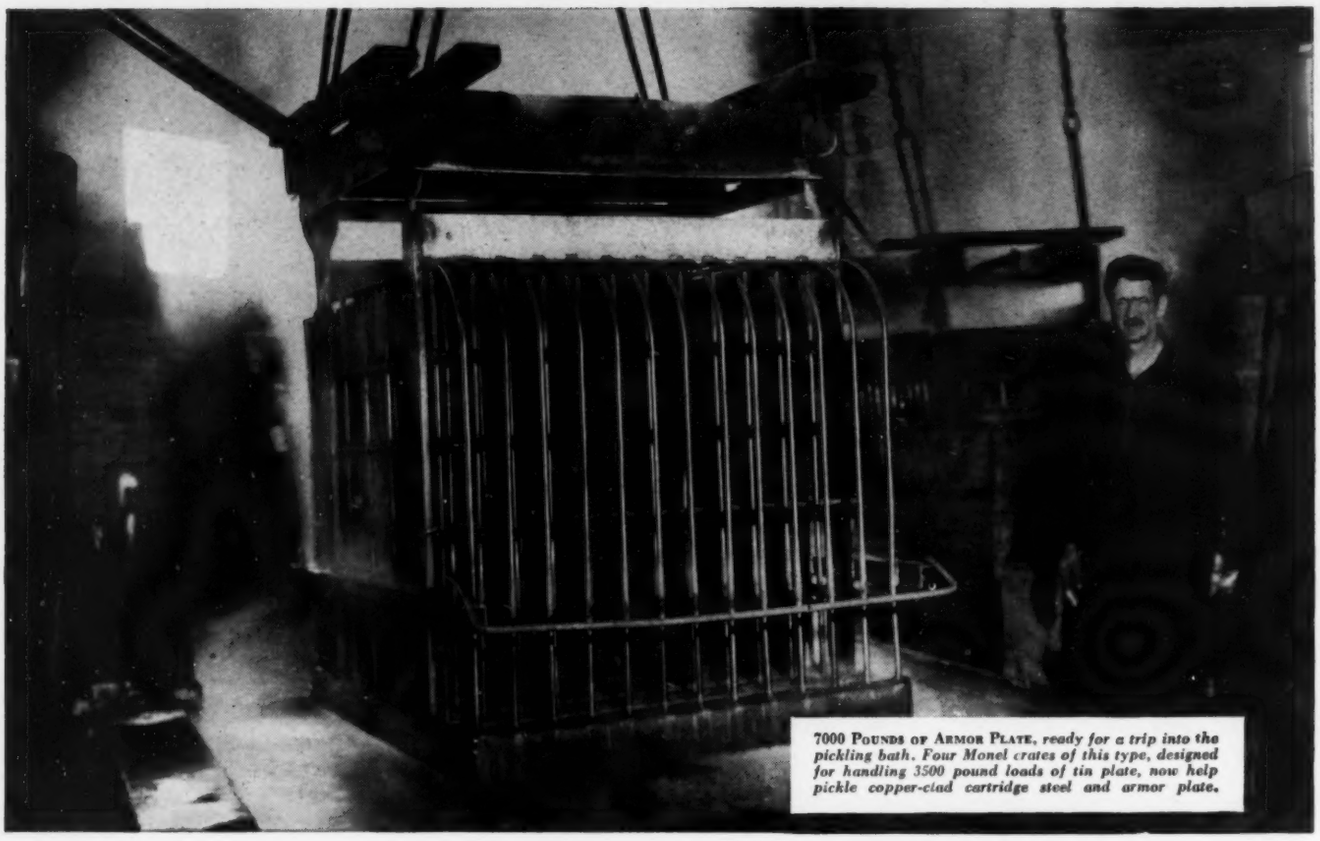
It is not a compromise for the ideal operating condition, but instead automatically adjusts itself to the load requirements. The advantages of such operation are—(1) fast acceleration of light loads, (2) longer time on heavier loads, (3) forced acceleration on abnormal loads.

These advantages result in improved operation due to less strain on motors and machines, ability to turn out greater production—better performance by operators since they quickly master the lightning response of these relays in taking the swing out of a crane hook, and similar light load conditions.

For your Direct Current Drives, ask for Bulletin 921 (Crane) and Bulletin 925 (Mill Auxiliary) Control. These descriptive bulletins will be gladly sent on request.

THE ELECTRIC CONTROLLER & MFG. CO.

2698 East 79th Street Cleveland 4, Ohio



7000 POUNDS OF ARMOR PLATE, *ready for a trip into the pickling bath. Four Monel crates of this type, designed for handling 3500 pound loads of tin plate, now help pickle copper-clad cartridge steel and armor plate.*

Steps up payloads to TWICE their pre-war weight

. . . Monel pickling crates, designed by Youngstown Welding & Engineering Co. handle DOUBLE tonnage for war production

Pickling crates that consistently handle double their planned-for payloads are doing a remarkable job, you'll agree.

Service of this kind means the crates were made *right* . . . of the *right* material.

The crates shown here were designed and fabricated of Monel by the Youngstown Welding and Engineering Company. Before the war, they were used for pickling tinplate in loads that averaged 3500 pounds.

When the mill switched over to producing armor plate and copper-clad cartridge steel, the loads were stepped-up to 7000 pounds and more. Despite this heavy added burden, the Youngstown designed Monel crates worked without a hitch. They have helped increase production substantially by their trouble-free service.

In the same mill, six other Monel crates also give evidence of Monel's great length of life under severe pickling conditions. After 13 years of service pickling high-silicon electrical steel sheets, they too are now in steady use, pickling armor and cartridge steel.

The unique combination of properties possessed by Monel makes it ideal for pickling room uses. Tough, strong, highly resistant to corrosion, Monel is excellent for pickling hooks, hangers, yokes and chains, as well as for crates and baskets.

For full information about the use of Monel in pickling please write The International Nickel Company, Inc., 67 Wall Street, New York 5, N. Y.

NICKEL (INCO) ALLOYS

MONEL • "K" MONEL • "S" MONEL • "R" MONEL • "KR" MONEL • INCONEL • "Z" NICKEL • NICKEL

Sheet...Strip...Rod...Tubing...Wire...Castings...Welding Rods (Gas and Electric)

ONE OPERATOR USING AN ELECTRIC PROPELLED TRANSPORTER DOES WORK OF THREE MEN HANDLING MATERIALS THE OLD FASHIONED WAY..

Now there is

No Straining • No Pulling • No Tugging • No Pushing

Realizing the need for increased production, Frankel Brothers Limited, one of Canada's leading industrial companies in the smelting and refining of secondary metals, included battery-powered TRANSPORTERS for their handling requirements.

In this type of business, where accuracy, speed, and uniform production are necessary, streamlined, sturdily-built, cost-saving, and safe TRANSPORTERS, with their trouble-free operation have been a real assistance in helping to turn out more war essentials.

The TRANSPORTER in an exceptionally wide variety of applications, demonstrates its flexibility, its ability to work in small areas, its ease of handling, and its advantages in moving greater tonnages speedily with safety and with the elimination of unnecessary handling.

• Send for Bulletins featuring other installations

We have a number of bulletins available, each featuring the TRANSPORTER at work in a different industry and pointing out the savings made.

ABOVE: *Metal being transported to its proper place in the store room.*

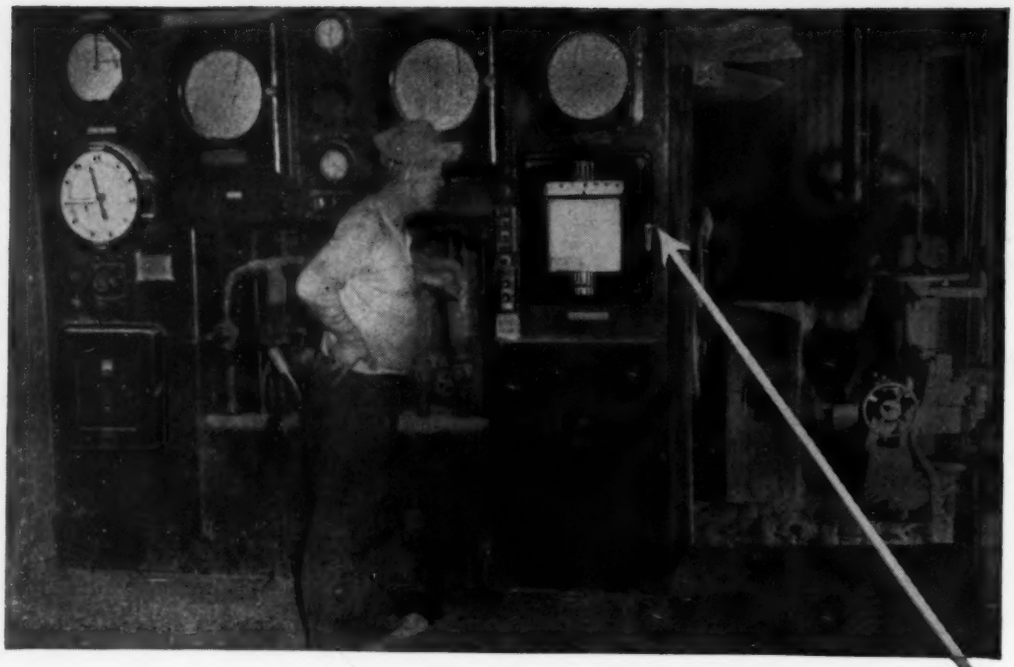
LEFT: *Heavy loads of metal are easily maneuvered with the Electric-Propelled* **TRANSPORTER.**

- **Positive Mechanical Brake with emergency Control**
- **Controls in Steering Handle**
- **Forward and Reverse Speeds**
- **Front Wheel Power Drive**
- **Shockless Hydraulic Platform Lift with Easy Foot Control**

MANUFACTURERS FOR OVER 38 YEARS *Electric Propelled* **INDUSTRIAL TRUCKS**

ELECTRIC INDUSTRIAL TRUCKS
MEMBER OF ELECTRIC INDUSTRIAL TRUCK ASSN.
208 South La Salle St., Chicago, Ill.

AUTOMATIC TRANSPORTATION CO.
47 WEST 87th STREET CHICAGO 20, ILL.
Division of the Yale & Towne Manufacturing Company



A Slogan For Every American

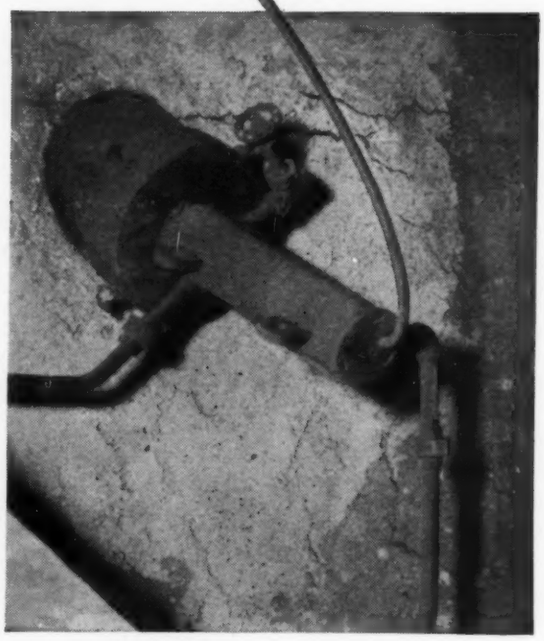
RAYOTUBES IN CHECKERS SAVE MONEY FOR INLAND STEEL

Inland's Indiana Harbor plant reduces maintenance costs by replacing the thermocouples in the checker chambers of their 36 open-hearth furnaces with Rayotubes. Where the thermocouples demanded considerable attention and burned out frequently, Rayotubes require little maintenance other than an occasional cleaning and checking. Once a Rayotube is installed, it's there to stay; it holds its calibration, and it *does not burn out.* Instead of going *to* the heat, as thermocouples do, Rayotubes stay in a safe location and receive radiation *from* the hot surface on which they are sighting.

And Rayotubes are giving Inland much better recorder readings than thermocouples formerly gave. This is partly due to the extreme sensitivity of Rayotubes; since they are sighted directly on the roof of the neck arch, with no protection tubes, they have no lagging and consequently detect every change in temperature the instant it occurs.

Another and equally important reason for the success of Rayotubes in this plant is that they measure temperature at a location which is too hot for couples. By thus working nearer the maximum, they assist the First Helper in avoiding refractory damage.

Our engineers will be glad to make specific recommendations for use of Rayotubes, or they will send Catalog N-33B, as you prefer.



This Rayotube at Inland Steel Co., Chicago, is mounted in the checker chamber wall of an open-hearth furnace. It receives radiation and reports temperatures to the Micromax Recorder (see arrow) by means of the lead-wire, just as a thermocouple would do.

LEEDS & NORTHRUP COMPANY, 4942 STENTON AVE., PHILA., PA.

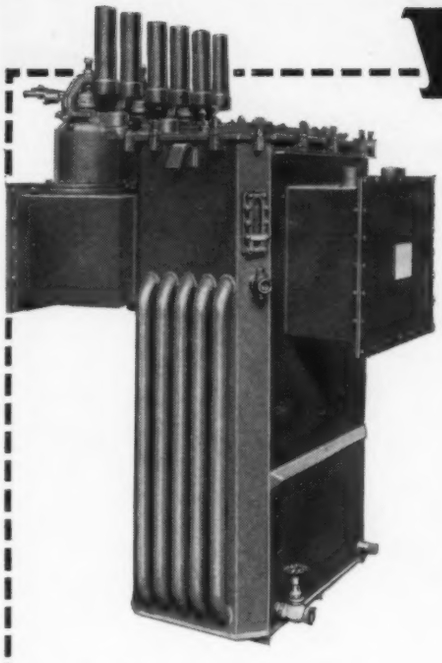
LEEDS & NORTHRUP

MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

Jrl Ad N-33B(6)

Wagner

can furnish a modern INDUSTRIAL-TYPE TRANSFORMER *for every Power need*

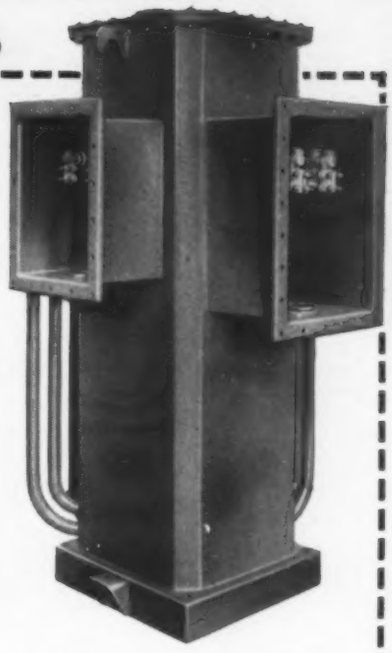


200-kva, 2400- to 480-volt Noflamol transformer with industrial-type terminal chambers for both high- and low-voltage connections.

No matter what your industrial transformer problem may be, Wagner has a modern industrial-type transformer to solve it. Air-cooled transformers can be installed to advantage for stepping down higher power-circuit voltage to allow connections of low-voltage appliances and machinery to the power circuit; for boosting voltage for small motors; and for phase changing.

Oil-filled, self-cooled transformers handle the largest loads with economy and efficiency. Noflamol transformers fill the need of a transformer containing a cooling and insulating liquid that retains the desirable characteristics of regular transformer oil but is noninflammable, thus giving safe dependable service installed in locations where regular oil-filled transformers would constitute a fire hazard.

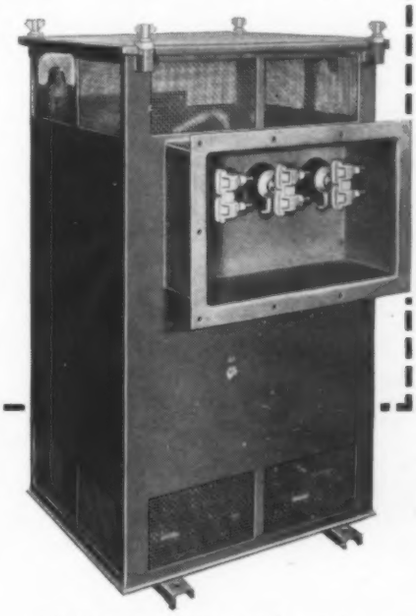
These are, of course, only a few advantages of Wagner's complete line of transformers. Contact the nearest Wagner branch for consultation on transformer problems for your individual plant.



A 150-kva, 3-phase, 60-cycle, 2400/4160Y- to 120/208Y-volt transformer equipped with a gang-operated G & W oil-fuse cutout on the high-voltage side and a low-voltage industrial-type terminal chamber.

Air-cooled transformer showing typical construction used for type AC, 10-kva and below, and type AA units through 25-kva.

This design provides a built-in junction box with removable coverplate, and knockouts on sides and bottom for conduit or open wiring. Jumpproof hanger lugs facilitate installation which can be indoors or outdoors.



100-kva, single-phase, 60-cycle, 480- to 120/240-volt type AC air-cooled transformer. Fabricated sheet-steel case designed for indoor service only.

These Bulletins are Yours for the asking!

You should have the comprehensive transformer information available in Bulletins TU-180 (Distribution), TU-181 (Power), and TU-33 (Noflamol). Also ask for GU-82 on the complete line of Wagner products. Write for them today.

TRANSFORMERS are but one of several **WAGNER PRODUCTS** serving industry.

Other **WAGNER PRODUCTS:**

AIR BRAKES
·
BRAKE LINING
·
HYDRAULIC BRAKES
·
INDUSTRIAL BRAKES
·
INDUSTRIAL BRAKE CONTROLS
·
TACHOGRAPH (Recording Speedometer)
·
ELECTRIC MOTORS

There is a Wagner Branch near you

Wagner maintains branches in 29 principal cities. These branches are manned by trained field engineers who will gladly work with you and show you how you can benefit by installing Wagner transformers.

ARMY E NAVY — NATIONAL SECURITY AWARD

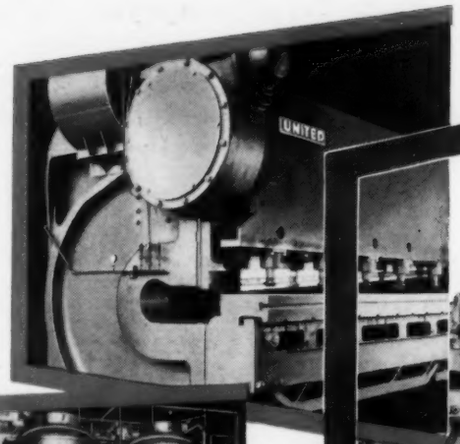
T45-9

Wagner Electric Corporation

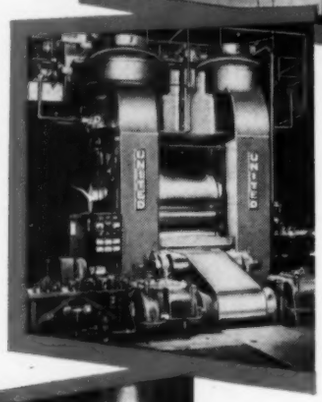
ESTABLISHED 1891

6483 Plymouth Avenue, St. Louis 14, Mo., U. S. A.

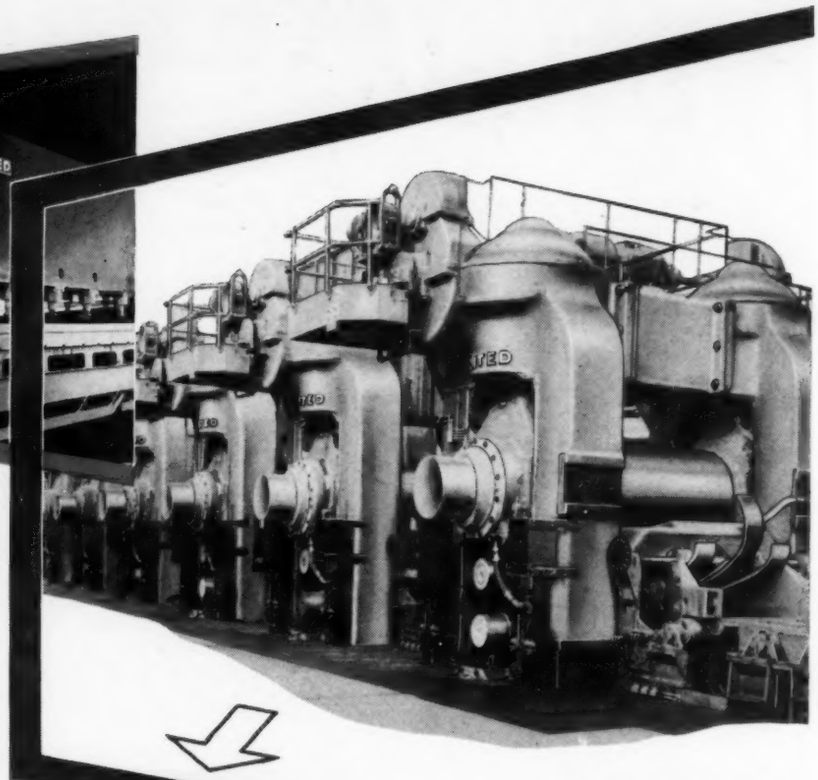
ELECTRICAL AND AUTOMOTIVE PRODUCTS



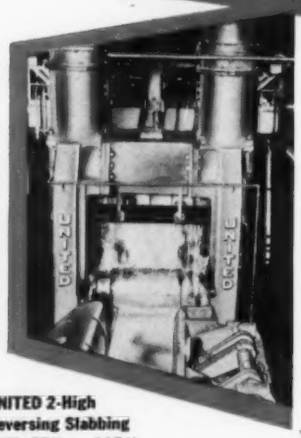
UNITED 156" Plate Shear



UNITED 4-High Cold Strip Mill 20½" & 49" x 54"



UNITED 4-High Hot Strip Mill 27" & 53" x 98"



UNITED 2-High Reversing Slabbing Mill 45" x 115"

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The World's Largest Designers and Makers of

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Rolling Mills

Blooming · Slabbing · Plate · Universal 2, 3, 4-high· 4-high Hot Strip · Bar · Rail and Structural · Merchant Rod · Sheet · Skelp · Pipe and Tube · 2 and 4-high Cold Strip · Tin · Uni-Temper.

In all types: Single Stand, One Way or Reversing, Tandem, Continuous, etc. For Carbon Steel, Alloy Steels, Copper, Brass, Aluminum and other Non-Ferrous Metals.

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"UNEFCO" Green Wabblers Grain and Chill · United Nickel Chill · United Moly. Chill · United Spec. Process UX Chill and Grain · H.D. Spec. Process · Lincoln Special · United Unidense · United Special Steel · United Carbon Steel · United Adamite · United VAN-X · United Super X · United Straight Chill.

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Transfers
Hot Beds
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Hot Strip Reels
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Hydraulic Presses
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Plate and Squaring Shears
Precision Levellers
Cone Type Uncoilers
Coil Boxes
Upcoilers & Downcoilers (Strip)
Cold Strip Reels
Cone Worm Drives
Gear Reduction Units
Generated Gears and Pinions
Continuous Strip Picklers
Semi-Continuous Strip Picklers
Rotary Strip Picklers
Electrolytic Strip Cleaning Lines
Electrolytic Strip Tinning and Coating Lines
United Mill Lubricating Systems
Material Handling Equipment
Portable Crop Shears
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Roll Lathes
Pressuremeters
Heavy Weldments
Annealing Boxes
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UNITED ENGINEERING AND FOUNDRY COMPANY

PITTSBURGH, PENNSYLVANIA

Plants at Pittsburgh • Vandergrift • New Castle • Youngstown • Canton

Subsidiary: Adamson United Company, Akron, Ohio
Affiliates: Davy and United Engineering Company, Ltd., Sheffield, England
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Electrical Way to Get More Ingots

—WITH AN ALLIS-CHALMERS ARC FURNACE SUBSTATION

LOWERING OPERATION costs and boosting ingot output of arc furnaces is the aim of Allis-Chalmers in designing unit-responsibility substations — like the one illustrated below.

Elements featured in the drawing are quick-acting Regulex electrode control, and a low maintenance furnace switch for disconnect duty, coordinated through the operator's control with furnace transformer and control current transformers.

The sturdy disconnecting switch is expressly designed for repetitive arc furnace duty. Only slight maintenance is needed . . . contacts are long-lived.

Allis-Chalmers also supplies a low-maintenance air blast interrupter for service up to 22,000 volts.

Revolutionary Regulex control, shown below, pays dividends to operators by making possible extra "heats" per day . . . because it's faster-acting.

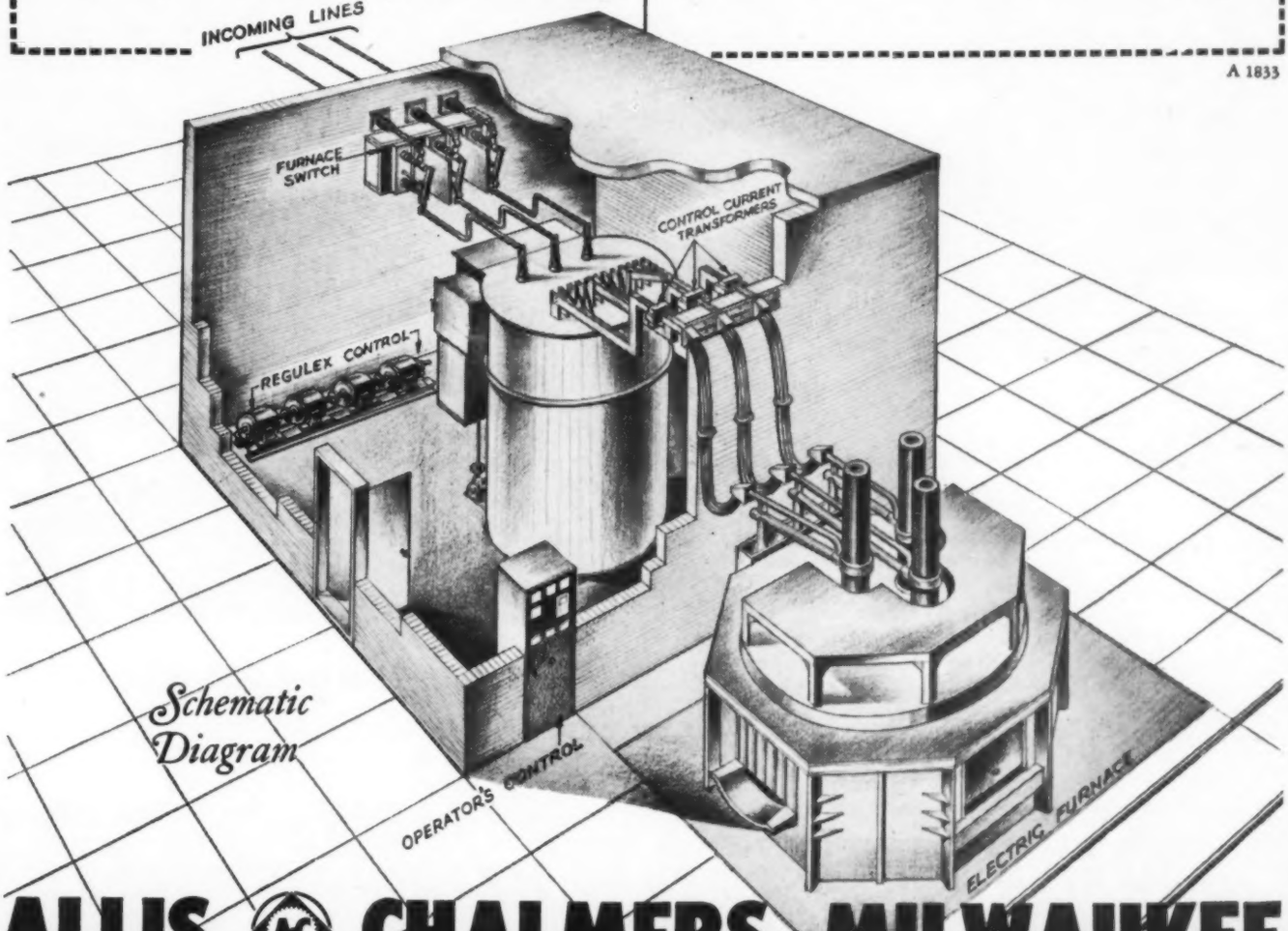
The Regulex set has no contactors to maintain. Its great amplifying characteristics and instant response to arc current and voltage eliminate power waste — and *all* with the ruggedness and reliability of standard rotating electrical machinery!

As added features, Regulex control can be equipped with flywheels which automatically raise electrodes when power fails, and an auxiliary generator, for making the control independent of a d-c shop source when desired.

Remember, Allis-Chalmers makes a complete line of furnace electrical equipment. There's undivided responsibility — no "buck-passing."

For complete information, call our district office. Or write direct to ALLIS-CHALMERS, MILWAUKEE 1, WIS.

A 1833



Schematic Diagram

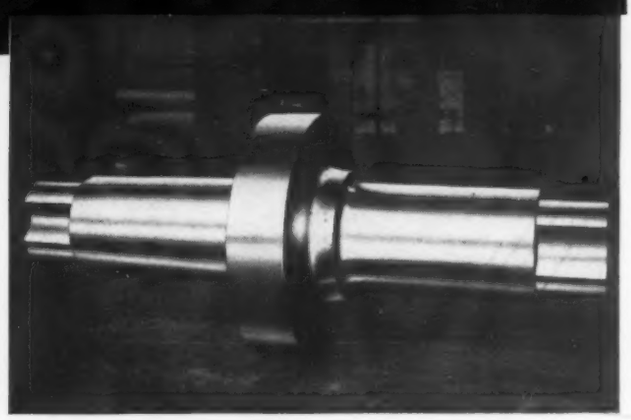
ALLIS AC CHALMERS · MILWAUKEE

CONTINENTAL ROLLS

2-Hi Skin Pass Cold Mill Rolls

Continental iron and steel rolls are recognized throughout the rolling mill industry for their ability to roll greater tonnage, their resistance to wear and for the sound construction which has been built into them.

In addition to iron and steel rolls, Continental also manufactures mill equipment and carbon and alloy steel castings. 4 plants—Chicago Works, Pittsburgh Works, Wheeling Works and Warwood Works.

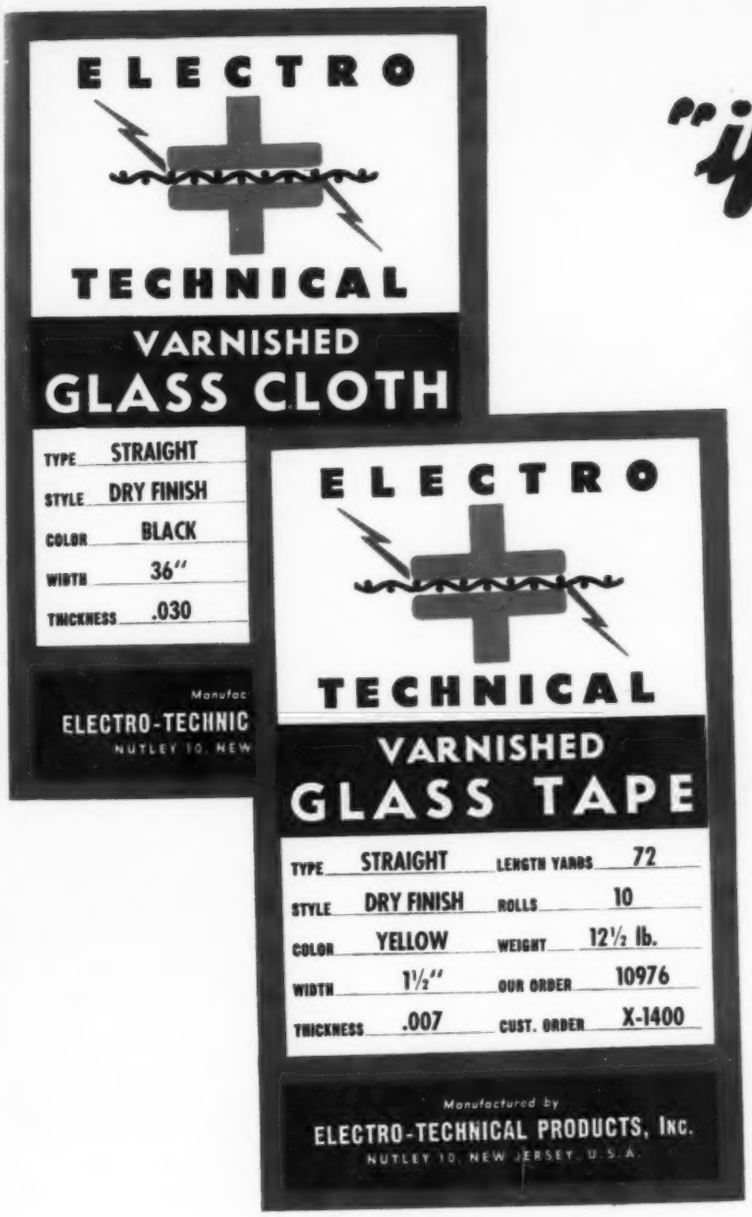


52" UNIVERSAL BEAM ROLL

CONTINENTAL *FOUNDRY & MACHINE COMPANY*

CHICAGO • PITTSBURGH

THE CUSTOM PROCESSED CLASS "B" WINDING INSULATION



without the "ifs-ands or buts"

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ELECTRO-TECHNICAL PRODUCTS, INC.

ELECTRICAL INSULATION DIVISION

115 CENTRE STREET, NUTLEY 10, NEW JERSEY

Branch Factories: LETCHWORTH, ENGLAND • LOS ANGELES, CALIFORNIA

Iron and Steel Engineer, June, 1945

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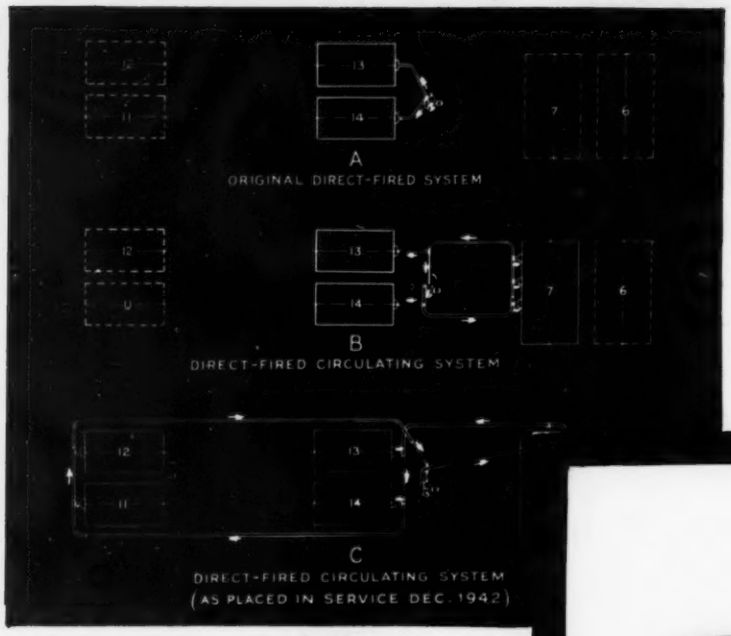
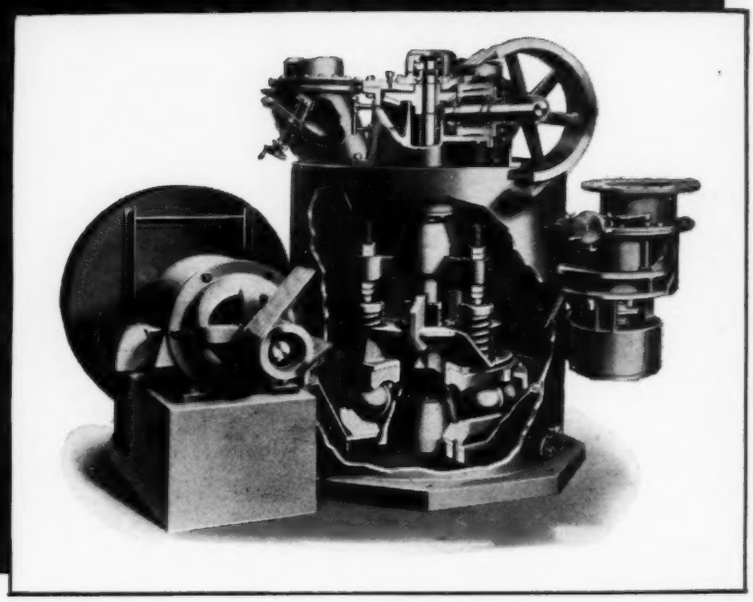


SAVINGS START HERE

with the B&W Direct-Firing Pulverized-Coal Circulating System



Cutaway view of B&W Type B Pulverizer

Substantial savings in installation, operating, and maintenance costs over other methods of firing metallurgical furnaces are made possible by the B&W Direct-Firing Pulverized-Coal Circulating System. A single pipe looped overhead and around several furnaces supplies air-borne pulverized coal of proper fineness to as many burners as are required for the service. Automatic control provides the same flexibility as obtained with oil or gas. With this method of firing, only ONE pulverizer is needed. It can be set where convenient; saving floor space and eliminating interference with product handling at the furnaces.

With this system you save fuel, reduce heating cycle time, and increase production. These savings begin at the heart of the system—the B&W Type B Pulverizer. Fuel distribution and capacity of the system, whether for single or multiple furnace operations, is assured because the Type B Pulverizer is built to stay on the job and to pulverize its rated capacity in coal to the fineness necessary for the specific requirements of each installation. This pulverizer is of the same type as that widely used for firing boilers and cement kilns, where sustained fineness and capacity of product and continuous low-cost operation are governing factors. They assure the same dependable service in this simplified method of firing metallurgical furnaces.

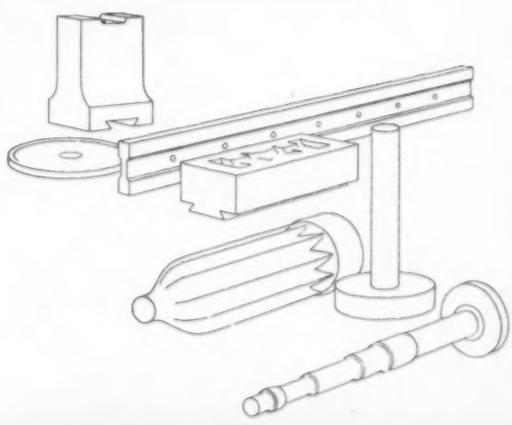
BABCOCK & WILCOX

PM-105

THE BABCOCK & WILCOX CO. **85 LIBERTY STREET, NEW YORK 6, N. Y.**

Heppenstall: the most dependable name in forgings

In charting your course of future business, it's well to remember that Heppenstall Forgings have a time-proved record for extra service . . . Dollar for dollar they'll cost you less to use—Heppenstall guarantees *it . . . Heppenstall Co., Pittsburgh, Pa.*



Your personal war effort is important!

PUSH PRODUCTION • PUSH BOND SALES

N•B•M #200 BRONZE BEARINGS BRIGHTEN YOUR PRODUCTION PICTURE

They have rolled up unheard-of records in mill after mill:

- 8 to 18 times longer service, with proportionate tonnage increase,
- Substantial savings in maintenance and power,
- More uniform gauge; freedom from cut roll necks, as compared to conventional babbitted shells.

Our engineers can do a lot to brighten your bearing picture. Why not consult with them today?

N•B•M
BRONZE AND COPPER CASTINGS

Blast Furnace Copper Castings • Roll Neck Bearings
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NBM

NATIONAL BEARING
DIVISION
PITTSBURGH • NEW YORK

AMERICAN Brake Shoe COMPANY

PLANTS IN: ST. LOUIS, MO. • PITTSBURGH, PA. • MEADVILLE, PA. • JERSEY CITY, N. J. • PORTSMOUTH, VA. • ST. PAUL, MINN. • CHICAGO, ILL.

COPPER BEARING ROLLS

Type Rolls (Pat.)

Birdsboro "30"
Birdsboro "40"
Birdsboro Metal
Curoloy
Grainloy
Superloy
Bronze Wabbler

Are you sure you are using cast rolls that are least susceptible to "firecracking"?

Rolls with "firecracked" rolling surfaces do not increase the quality of the surface of rolled products.

Birdsboro Copper Bearing Rolls—because of their rapid heat-dissipation characteristics—reduce "firecracking" to a minimum.

Consult our roll engineers regarding our "individualized" roll service for answers to your roll problems.

BIRDSBORO STEEL FOUNDRY & MACHINE COMPANY • BIRDSBORO, PA.

BIRDSBORO
ROLLS

TUNE OUT VIBRATION

THE FLUOR PULSATION DAMPENER tunes out vibrations caused by pulsative flow in pipe lines, ducts or related equipment carrying air, vapors or gases by converting the pulsative flow into a steady stream. Whenever a pulsative flow exists, there is usually some portion of the piping or duct system which has a natural frequency in tune with either the fundamental pulsation frequency or one of its harmonics. By eliminating the pulsations in the flow, the vibrations originated by them are literally tuned out. Thus, the Fluor Pulsation Dampener stops vibration by eliminating the cause.

Patents Applied For

FLUOR

ENGINEERS • MANUFACTURERS • CONSTRUCTORS

PROCESS PLANTS AND EQUIPMENT FOR THE OIL, GAS AND ALLIED INDUSTRIES

THE FLUOR CORPORATION, LTD., 2500 S. Atlantic Blvd., LOS ANGELES 22 • New York, Pittsburgh, Kansas City, Houston, Tulsa, Boston

Oliver Gray, Roll Grinder, has put in 36 years in the Industrial Service at Lewis. Today, many of the Rolls he has finished are rolling steel which may be part of the equipment his three sons in the Armed Services are depending on . . . Pvt. Oliver Jr. is with the Aviation Signal Corps in Italy . . . Pvt. Harold with the Army Air Corps Ground Forces . . . Seaman 2/c Walter is somewhere with the Navy.

Oliver is proud of his sons—proud of his job at Lewis.

ARMY E NAVY

Also manufacturers of
ROLLING MILL MACHINERY
for the iron, steel and
non-ferrous industries

LEWIS FOUNDRY & MACHINE
Division of BLAW-KNOX Company, Pittsburgh, Pa.

LEWIS ROLLS

Kathanode

PLUS CAPACITY

PAYS DIVIDENDS

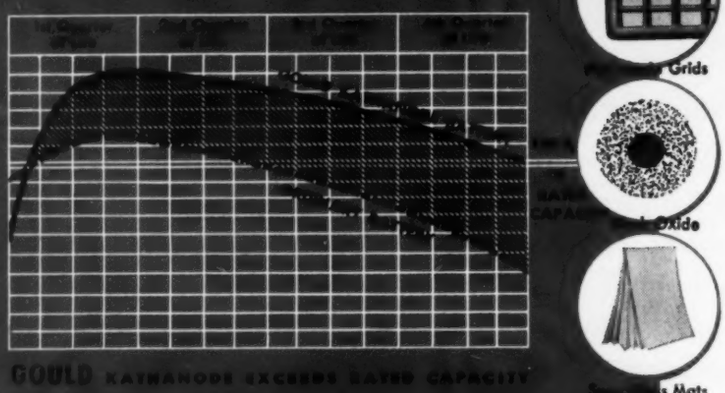
in extra materials handled

The shaded area in the graph below shows the *excess capacity* of the Kathanode battery. From beginning to end of service life it is greater than that of ordinary batteries.

With the minimum of catalog rated capacity available at all times throughout the life of Kathanode, your trucks will run with undiminished speed throughout their daily shift, during the full span of their battery life.

Costly delays due to changing of batteries during shifts, because of premature reduction of capacity, is avoided when you use Kathanode batteries.

For industrial trucks battery power is best and Kathanode is the best battery power. Write Dept. 46 for Catalog 100 on Gould Kathanode Glassklad Batteries for Industrial Truck and Tractor Service.



GOULD

GOULD STORAGE BATTERY CORPORATION, Depew, N. Y.

"3C" TAKES ON A NEW MEANING . . .
CAPACITY-CAPABILITY-CONTINUITY

(No. 2 of a series of Advertisements)

CAPABILITY

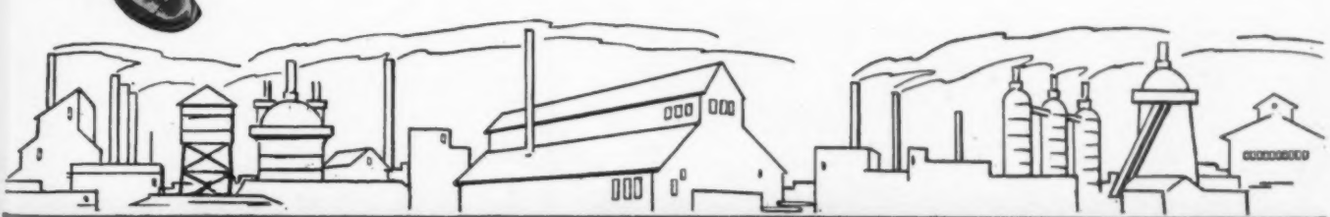
In the "3C" organization, the Application Engineers are the connecting links between our plant and users. These Application Engineers have highly developed CAPABILITY in solving Electrical Control problems.

"3C" Application Engineers are:—

1. **Specialized Electrical Engineers**
2. **Versatile in their experience with "3C" Control**
3. **Solvers of Electrical Control problems in all sorts of applications.**

This is what we *mean* by CAPABILITY.

For CAPABLE control apparatus Applicationeered by CAPABLE men, contact the nearest "3C" Office.



THE CLARK CONTROLLER CO.

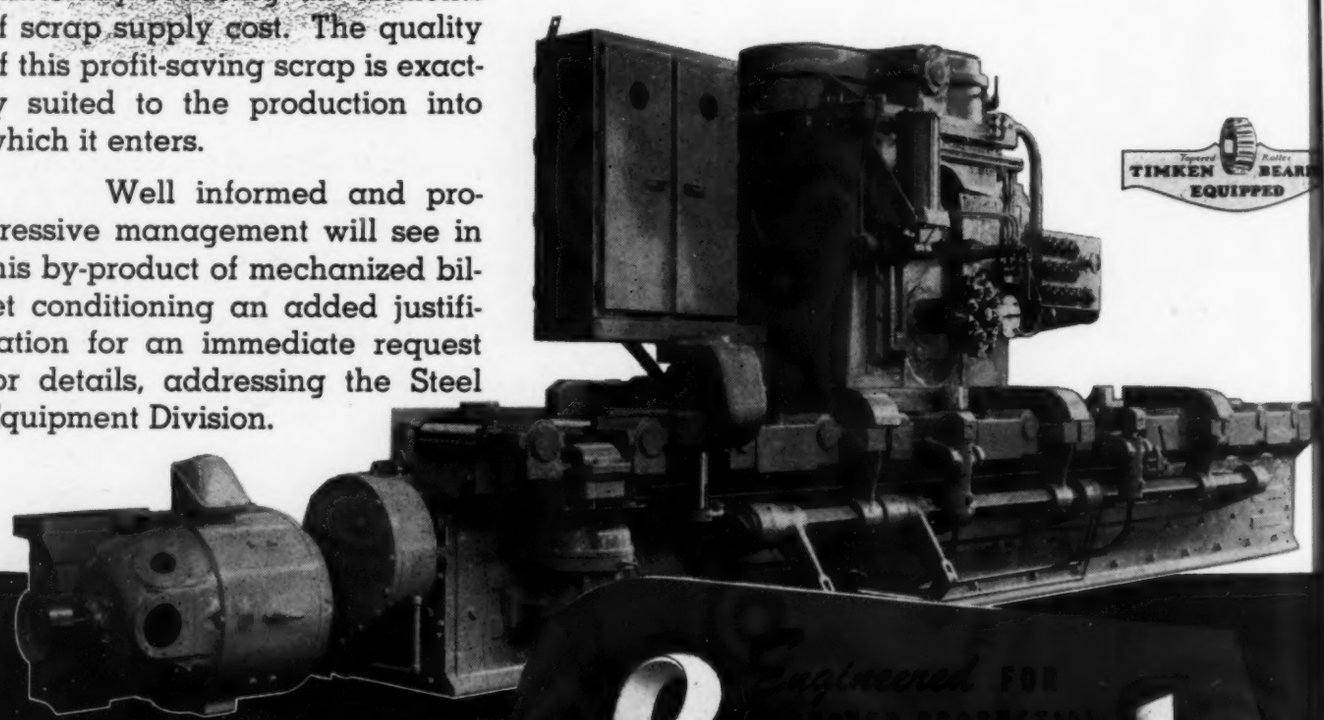
1146 EAST 152nd ST., CLEVELAND 10, OHIO • EVERYTHING UNDER CONTROL

372,000 lbs. OF HIGH GRADE SCRAP MONTHLY!

EQUIP TO SAVE . . . . . on Billeteer operation, not only in general chipping and salvage of billets on which cleaning cost would be prohibitive, but also in the easy recovery of high grade steel scrap in the form of chips, commonly lost in other methods of billet cleaning.

One mill, now operating four Bonnot Billeteers, recovers 3,100 pounds of chips daily per machine. These return immediately to the furnace, materially reducing all elements of scrap supply cost. The quality of this profit-saving scrap is exactly suited to the production into which it enters.

Well informed and progressive management will see in this by-product of mechanized billet conditioning an added justification for an immediate request for details, addressing the Steel Equipment Division.



MECHANIZE YOUR BILLET CONDITIONING NOW. PREPARE FOR TOMORROW'S INTENSIFIED COMPETITION.

Engineered FOR

Bonnot

THE BONNOT COMPANY

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BUILDERS OF **THE BILLETEER**

ADDRESS CORRESPONDENCE TO

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English Representative: International Construction Co., 56 Kingsway, London, W. C. 2, England

Your 4 Best Oil "Specifications"

Socony-Vacuum's 4-Factor Story

☛ No matter what machines you operate—you'll find that your best specifications for oil or grease are *ultimate results.*

☛ You're not interested in the oil or grease as such. You're after continuous production, uninterrupted by machine failure. You want lower maintenance costs from maximum machine protection, reduced power consumption from lower frictional losses and, finally, you want lower lubrication costs.

☛ In short, what you want are the 4 factors of Socony-Vacuum Correct Lubrication—the 4 factors that add up to lubrication profits for your plant.

☛ You can get these 4 factors now with Socony-Vacuum's *complete lubrication program* for your plant. For this program not only means the best quality lubricants for specific needs, but also includes skilled engineering counsel for scientific application, latest storage and handling methods, charts, controls and even progress reports of benefits obtained.

See your Socony-Vacuum representative and *specify* the 4-factor story for your lubrication dollars.

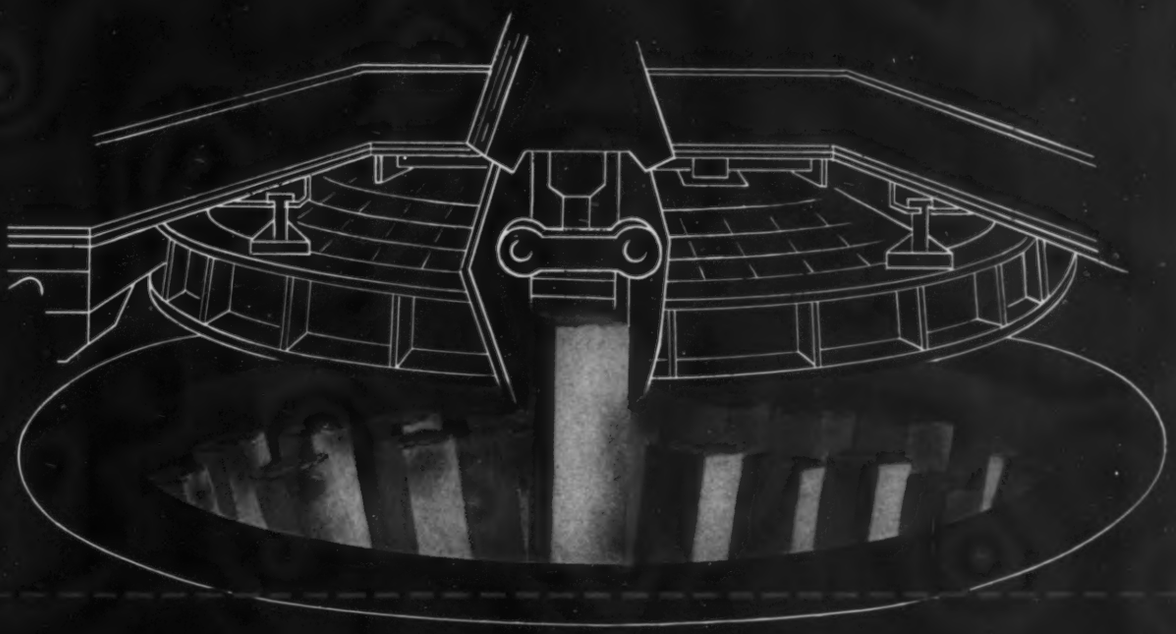
GARGOYLE Lubricants

Call in SOCONY-VACUUM *for Correct Lubrication*

SOCONY-VACUUM OIL COMPANY, INC., Standard Oil of N. Y. Division • White Star Division • Lubrite Division • Chicago Division
White Eagle Division • Wadhams Division • Magnolia Petroleum Company • General Petroleum Corporation of California

the men who know say this about

SALEM CIRCULAR PITS



PIT MAN

"The Salem Circular is a 'real' pit for pit men. Automatic temperature control plus a foolproof cover means less guesswork, therefore less trouble."

ROLLER

"Ingots heated in a Salem Circular Pit make the rolling job a lot easier. They're nice and soft and that's the way we want 'em for tonnage production."

SUPERINTENDENT

"We save money on every ton of steel conditioned in our 20' Salem Circular Pit. We can prepare ingots faster and we have less trouble all along the line than with any other type pit."

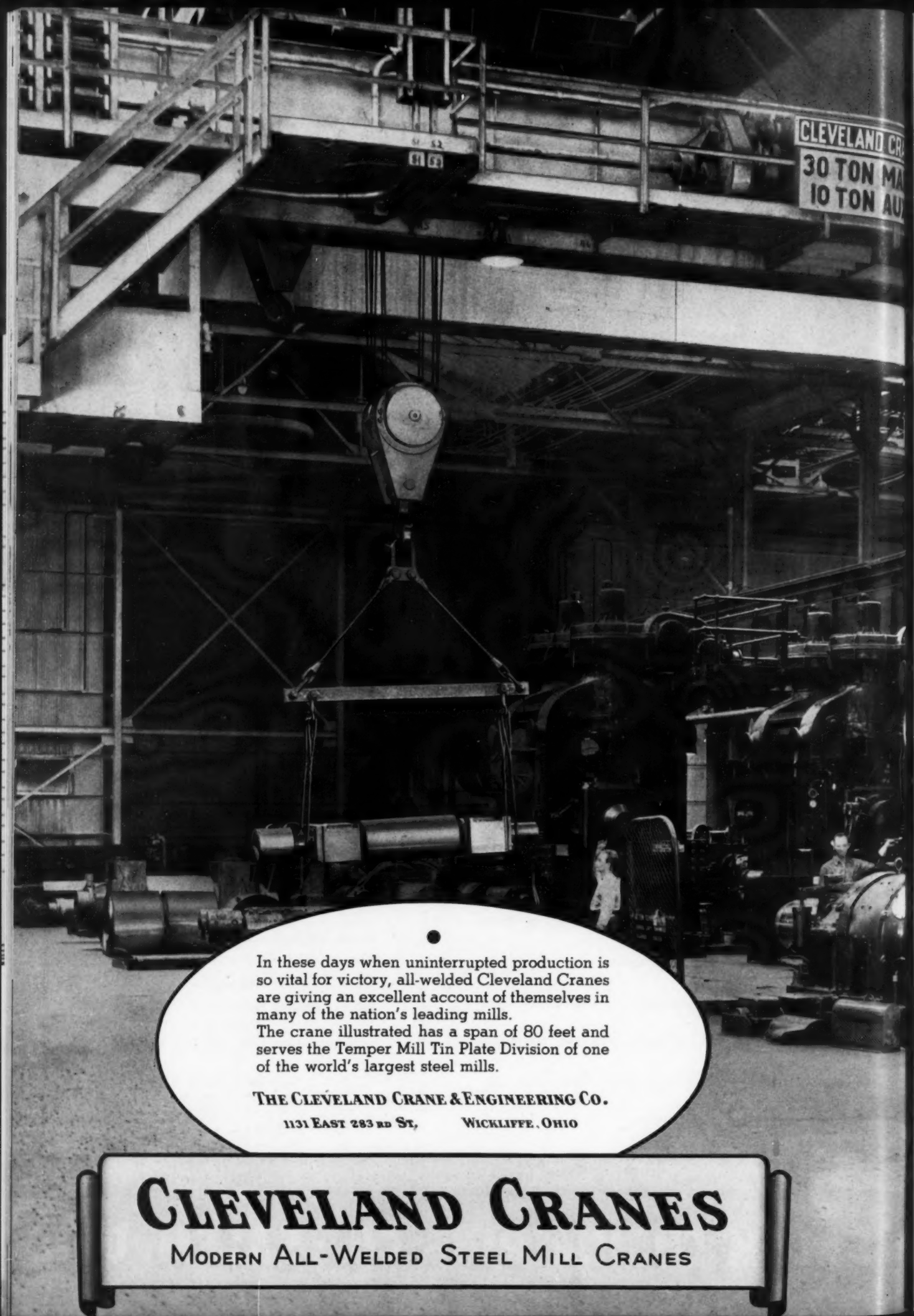
The circular design offers 16 distinct advantages but the end result is the most important. As proved by operating records of hundreds of installations in mills in the United States and in other countries, Salem Circular Pits reduce conditioning costs.

Salem builds the Circular Pits in diameters between 8' and 20' utilizing any conventional fuel. We also engineer all types and sizes of heating furnaces.

Send Salem Your Heating Inquiry

SALEM ENGINEERING COMPANY

SALEM ENGINEERING CO. · SALEM, OHIO



In these days when uninterrupted production is so vital for victory, all-welded Cleveland Cranes are giving an excellent account of themselves in many of the nation's leading mills.
The crane illustrated has a span of 80 feet and serves the Temper Mill Tin Plate Division of one of the world's largest steel mills.

THE CLEVELAND CRANE & ENGINEERING CO.
1131 EAST 283 RD ST, WICKLIFFE, OHIO

CLEVELAND CRANES

MODERN ALL-WELDED STEEL MILL CRANES

Crops *and* Shorts

RECOMMENDATIONS recently made by the steel committee of the Western States Council to federal government agencies include the following:

1. Western steel prices must be lowered so as to compare with prices paid in other industrial centers.
2. Government owned mills must be passed on as soon as possible to private owners who must adopt price policies omitting all charges not based on actual costs and abolishing the present pricing formula.
3. Valuation and financing should be such that Fontana and Geneva are comparable in capital costs to the private owner.
4. All steel producers should set up western steel prices based upon production cost at western mills.
5. Postwar operation at Geneva will require material reductions in freight rates on finished steel to western markets.

▲

IN case you're stuck as to what to buy your wife for that birthday or anniversary, you might be glad to know that WPB has lifted its prohibition on the use of metal to make wash boards, carpet beaters, dust pans and numerous other items.

▲

TWENTY 3 in. pipe lines laid under the English Channel soon after D-day carried an average of 1,000,000 gallons of oil per day to the Allied forces in Europe. Conceived by Lord Louis Mountbatten, the lines were specially constructed to withstand an internal pressure of 1200 psi, as against the 10 or 15 psi internal pressure which average cables previously manufactured carried.

▲

PROJECT work is under way on facilities for the production of sheet, tinplate and tubular products at the Fontana, California, plant of Kaiser Company, Inc. These new facilities, estimated to cost $52,000,000, will enable the Kaiser plant to turn out products used in considerable quantities in the Western states. Financing is said to be planned on a private bank loan, contingent upon RFC approval of terms proposed by Kaiser for repayment of their original construction loan.

▲

MANY of the experts expect both business and individual incomes to decline from what they feel is the present peak.

ACCORDING to the American Iron and Steel Institute, the steel industry must spend $200,000,000 to reconvert plants and equipment to the production of peacetime products. This does not include any expenditures which companies are planning to broaden their operations.

▲

ADD to the signs of the times the fact that cost meetings — those torture racks of the nineteen-thirties — are reappearing in the steel plants. This move toward more economical operation is, however, a healthy trend. A recent visitor from Britain was firmly convinced that they could live on what is wasted in the United States.

▲

A PAT on the back develops character — if administered often enough, young enough and low enough.

▲

ALTHOUGH WPB has given the official green light for the production of 200,000 passenger cars this year, don't rush down to your dealer with an order. Production may be held up by a lack of tin, lead, textiles, chemicals and rubber, all critically tight.

▲

PROJECTILES with a core of tungsten carbide and a housing principally of aluminum were found particularly effective in piercing armor plate. Weighing only 9 lb as compared to 15 lb for a conventional shell of the same size, a muzzle velocity of 3400 fps is attained against the regular 2800 fps, resulting in higher firing accuracy.

▲

A NEW publication, "Steelways," published quarterly by the American Iron and Steel Institute, is designed to set forth interesting and new uses for steel. The initial issue contains eleven well-illustrated nontechnical articles dealing with various phases of the industry and the application of its products, and includes one discussing surgical instruments, accompanied by some gory color photographs that should be inspected only when there are no butterflies in your stomach.

▲

FREE China's steel capacity, according to returning experts of the Nelson mission, consists of three 10-15 ton open hearth furnaces plus three more under construction, seven 1-2 ton converters plus six more not operating, and ten small electric furnaces which are operated when and if electrodes and power are available. Production in 1944 totaled 16,000 tons, an average operating rate of 37 per cent, and coal consumption was 10 tons per ton of steel.

▲

THE United States Steel Corporation will sponsor the Theatre Guild in a series of programs over the coast-to-coast network of the American Broadcasting Company (Blue Network). The series which will start September 9, 1945, and be heard every Sunday evening from 10 to 11, E.W.T., will not limit itself to Guild plays, but will draw its material from the most popular productions in the entire theater.

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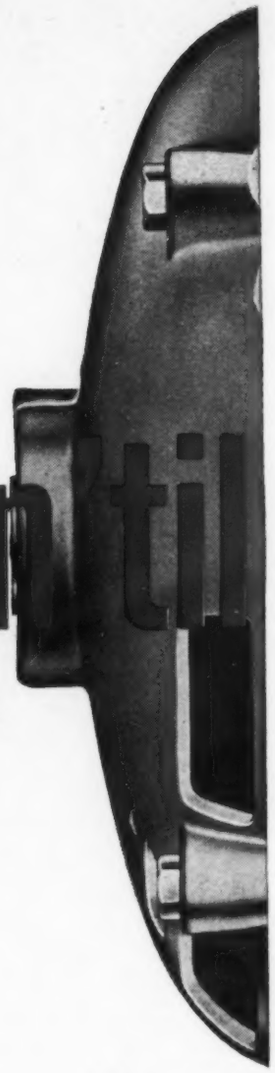

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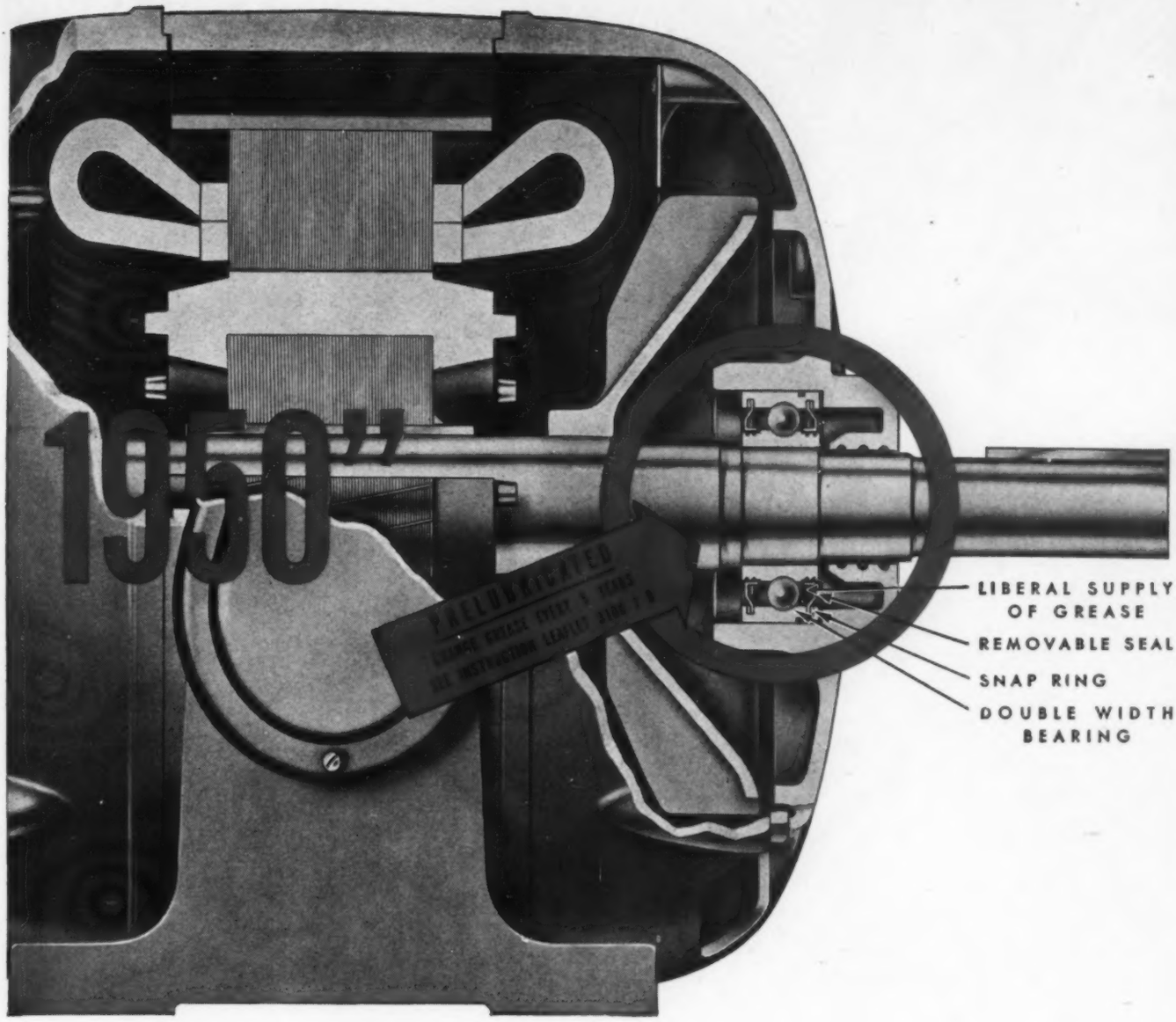

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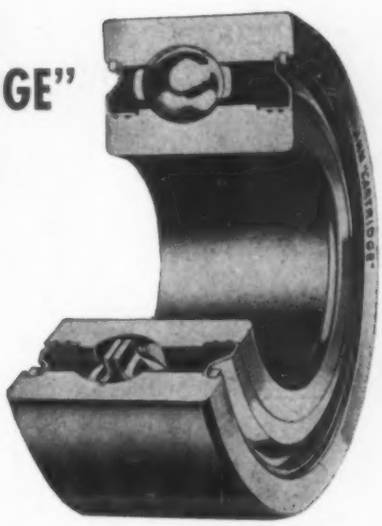

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Iron and Steel ENGINEER

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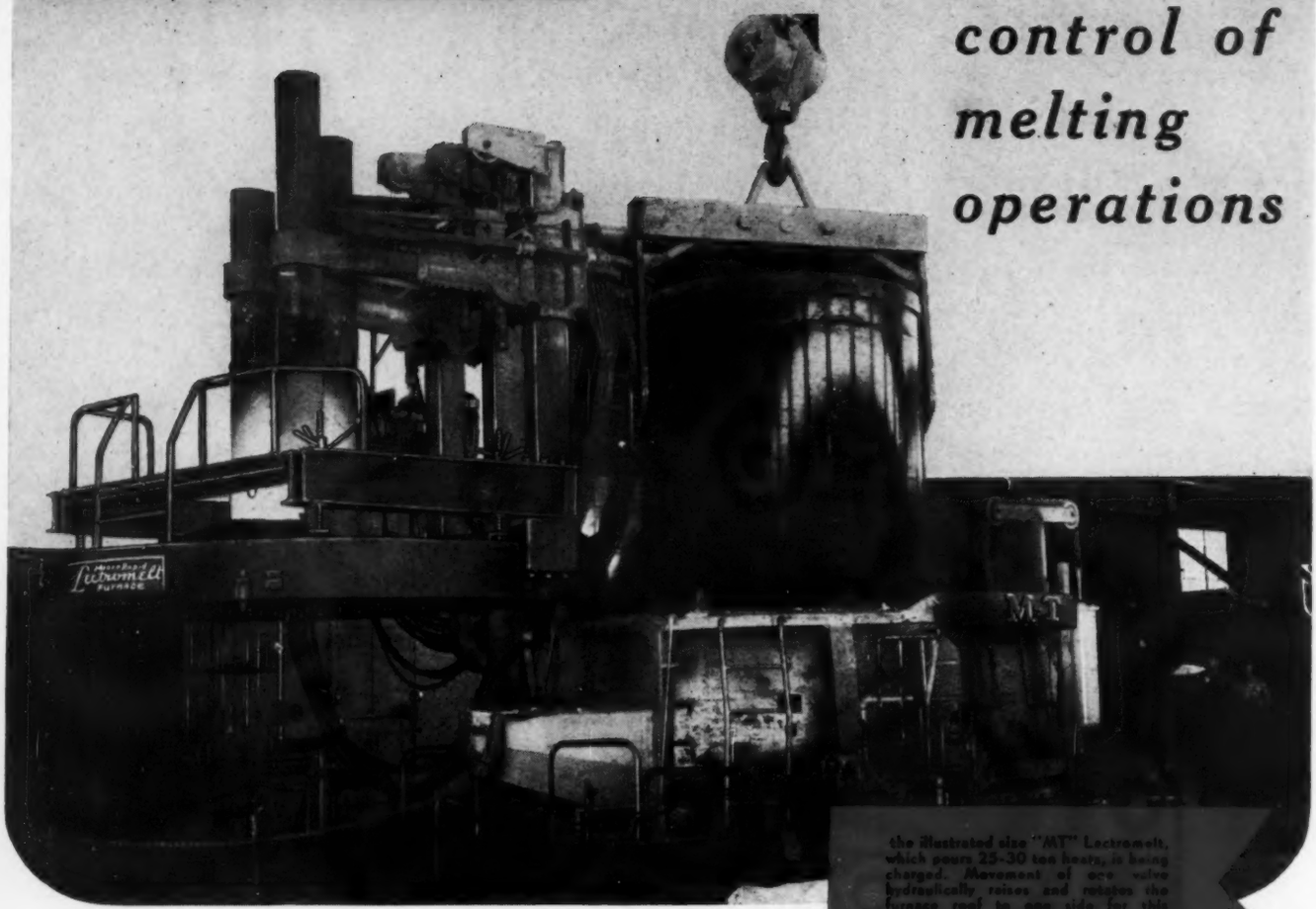

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THE Krause Mill Reduction Line

. . . . performing a very heavy reduction in a single pass, this mill may fit into a continuous production line with equipment for cleaning, annealing, etc. . . . . experience with two units on nonferrous production indicates possibilities for the steel industry . . . .

by P. M. MUELLER

CHIEF ENGINEER IN CHARGE OF DEVELOPMENT

BLAW-KNOX COMPANY

PITTSBURGH, PENNSYLVANIA

▲ ONCE in a while a new idea comes along which dovetails so neatly into the scheme of things that it complements and completes what has seemed an otherwise insoluble problem. Just such a new idea is the Krause principle of rolling. It fits with dovetail exactness into the production rolling of brass and copper strip and, in association with certain new auxiliary equipment, will provide a means for cheapening costs and improveing product without any serious dislocation of familiar techniques or existing equipment.

There are interesting applications for the method in steel and the other malleable metals, but to keep this paper within a reasonable limit, the discussion will be confined to the application to the production of brass and copper strip alone.

For such an application the basic scheme, as at present conceived, contemplates the combination of the Krause mill proper, preceded by means of joining short, thick, slab stock which is fed to the mill as a continuous heavy gage strip, and followed by continuous annealing, cleaning and edge trimming equipment, all in one straight line from slab to thin, soft reeled strip.

Because the mill makes a very high percentage reduction in the one pass and thereby delivers at relatively slow speed, it becomes possible to make the "in line" combination with the above mentioned auxiliaries, and have all units of reasonable size and designed for good balance and efficiency.

Presented before A. I. S. E. Pittsburgh District Section Meeting, February 12, 1945.

The mill proper is now in the commercial stage of development with two installations in the nonferrous industry. Mr. Frank Krause, the inventor, has been working on its conception and its development as an engineering accomplishment for the past ten years (Iron and Steel Engineer, August 1938) and has conducted experiments with many classes of material on a pilot mill built by the Lewis Foundry and Machine Division of Blaw-Knox Company and installed in their shops.

This work has definitely established that the method will reduce any metal which can be wrought cold to a high degree of elongation in one pass through the machine — this without introducing an abortive amount of undistributed strain in the strip and with an inconsequential amount of edge cracking. It has also shown the ability to control gage, either from side to side or end to end, to a marked degree and to correct variations in entrance gage as well.

The design of the auxiliary equipment has progressed beyond the purely experimenal stage and full scale production units are now being built. These will be released later for further development under commercial conditions.

In many ways the Krause design is similar to familiar methods of strip rolling — in others, quite dissimilar. For instance, the rolling head is comparable to any four-high mill. The pinch is taken between two rather small work rolls backed up by the so-called cam plates which

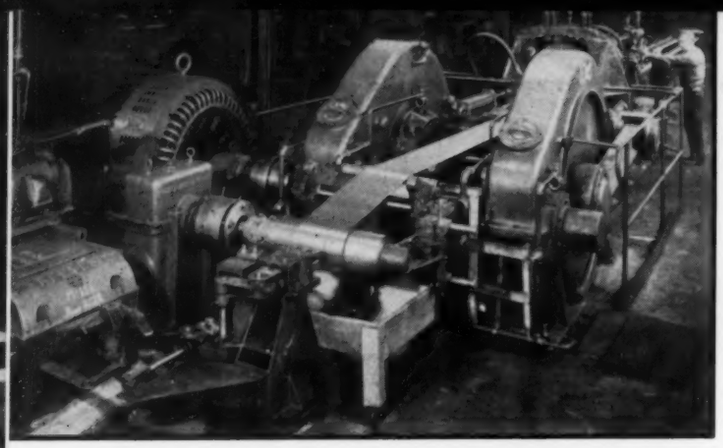


Figure 1 — View of mill from the delivery end, showing drive motor, reduction gear case and coiler.

▲

Figure 2 — The reciprocating head shown at left is actuated by drive cranks attached to the gear of the reduction unit.

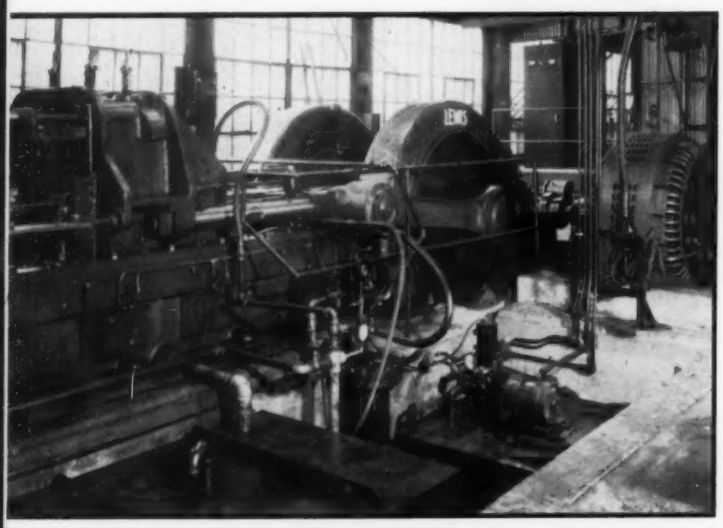
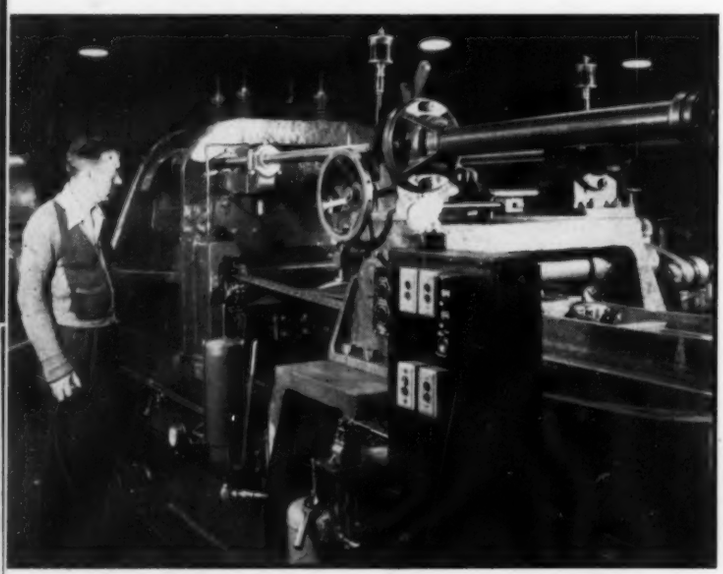


Figure 3 — All controls for starting and stopping the drive motor, feed motors and coolant pumps, and for adjusting gage are located at the operator's position.

▲

Figure 4 — A gripper mechanism travels along the feed table under the action of a large screw, controlling the slab feed to the mill. (right)



function exactly as do the backing rolls of the four-high — that is to say, they provide the support.

The rolling head frame differs from the four-high configuration in vertical height. The cam plates are shallow and can be held in a short chunky frame to take the separating force. There is no great length of housing post under tension, and consequently considerable stiffness is attained without a great mass of metal.

Secondly, the reduction power is transferred to the rolls solely by tension in the strip, as in the familiar "Turk's head" rolling, or as with a Steckel mill. But, whereas the Turk's head or the Steckel unit stands still while the strip is pulled through the stationary pinch, Krause keeps the work still, and the work rolls and the pinch are given the motion. The difference is one of relative motion only.

Third, the rolling head is reciprocated much like a tube reducer, taking a succession of short bites as the head goes back and forth, and as the thick stock is fed into the machine. The tube reducer, however, rolls uphill against the incoming stock which is under compression, while the Krause mill rolls down-hill on the other half of the stroke, keeping the stock under tension in the pinch and taking advantage of the considerable reduction of separating force which accompanies the tension. The action is much like pulling taffy.

As a last comparison, in ordinary rolling a moderate reduction is taken throughout the complete length of the strip in one pass at relatively high speed. This is repeated by bringing the coiled strip back to the mill as many times as is necessary to obtain the desired overall reduction. The metal is then annealed to remove the work hardening, cleaned and returned to the mill for a second campaign of passes.

In brass, where the annealing points are generally spaced by 50 per cent reduction, there may be as many as four or five cycles of rollings and annealing in the rundown range before the desired gage is reached. The familiar method is characterized by a plurality of moderate passes at high speed, interspersed with several annealings and cleanings, all as separate operations or handlings.

The character of the Krause method differs in every particular and there is no point of similarity. A heavy reduction is taken in one pass through the mill, all

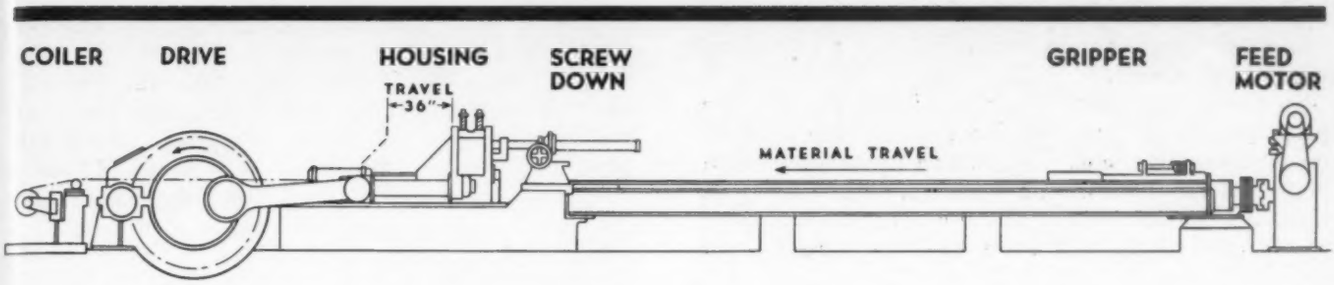


Figure 5 — General arrangement of the mill installed in a brass plant in the Pittsburgh district.

classes of rolling, from thick-soft to thin-hard, being accomplished in one stroke of the rolling head. The low delivery rate allows the combination of annealing and cleaning auxiliaries in line with the mill to form a complete reduction line, accomplishing in one handling all that has been done with many handlings by the older method. It is in this simplification of handling that we expect to find the best economic application of the method.

These points of difference and of similarity become more apparent from examination of the illustrations of an existing installation. Figure 1 looks at the mill from the delivery and drive end. A single reduction of pinion shaft and bull gears is coupled to the main motor. What would ordinarily be a single herringbone gear is split into two helical gears, separated to provide a path for the emergent strip, which is clearly shown with several starting wraps on the reel. The crankpins are let into the outer webs of the bull gears and one of the connecting rods which give the reciprocation to the main rolling head can be seen to the right inside the guard fence.

Figure 2, taken from the side away from the operator, shows the cranks, crosshead and main rolling head (at left center) to better advantage. The reciprocating ways form the main machine frame. Roll coolant and lubrication oil tanks are in the pit in the foreground. This pit is ordinarily covered with flush grill flooring.

Figure 3, at the operator's position, gives a closer view of the main rolling head. All the controls for starting and stopping the main motor, the feed and return motors, coolant pumps, etc. are located in one panel convenient to the operator's hand. The handwheel, just above and to the left of the control panel, is the gage adjustment. This can be clutched to either screwdown or to both simultaneously.

Figure 4 shows the outboard end of the feeding bench. This consists essentially of a heavy columnar frame with ways in which the gripper carriage slides. The carriage is positioned and driven by a large screw running the full length of the ways. The one motor at the far end is for quick return to starting position, while the other motor, driving through the variable speed transmission, gives the slower motion forward for the feed. Once the rolling has started, this bench is less a feed device than an escapement mechanism. The heavy tension in the strip tends to over-drive, so that the feed motor merely controls the position of the gripper slide by turning the lead screw.

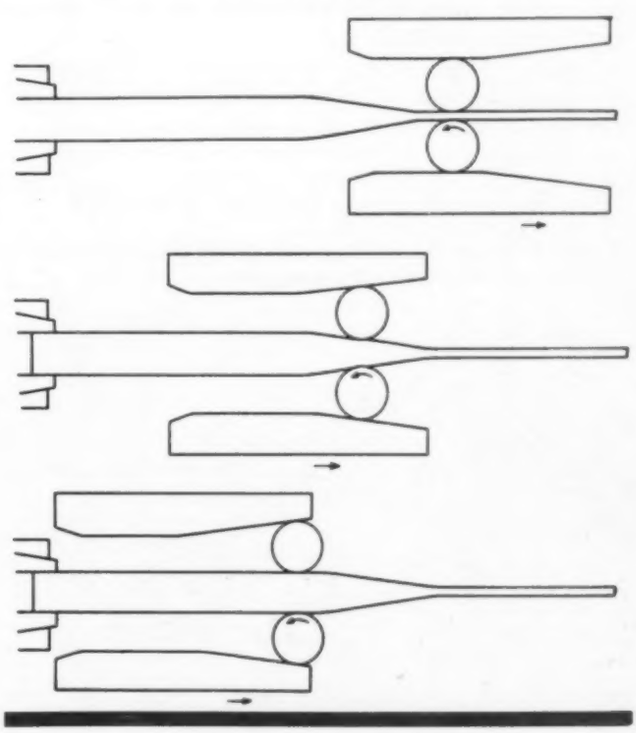
All of the photographs just commented on add up nto the line drawing of Figure 5.

Now with the general picture more or less complete, we can begin to look at some of the interior details which actually do the work. Figure 6 shows in schematic fashion what happens at the reduction point. Two work rolls, 4 in. in diameter by 28 in. face width, engage the stock, rolling down the reduction wedge from the thick entry gage to the thinner delivery gage.

The rolls are forced into the stock by the two cam plates. These cam plates are supported rigidly in the main rolling head. They therefore oscillate back and forth through the 36 in. stroke of the main head.

The contour of the cam plates is such that they drive the work rolls down-hill for a portion of the forward stroke and then flatten out into an ironing pass for the second half of the forward stroke. This is illustrated more clearly by drawing three views (Figure 6) showing the rolling stroke as it proceeds. In the first view (top) the cam plates have just started forward and have wedged the rolls together until they just begin to sink into the full thickness of the slab. The rolls are now in strong frictional contact with both the cam plates and the stock and will start to roll down-hill at half the for-

Figure 6 — These sketches indicate the action of the cam plates and rolls in reducing the slab.



ward speed of the cam plates. If you roll a pencil between the palms of your hands, you can get this half speed idea exactly.

In the second view (Figure 6, middle) the rolls are part way down-hill and still jammed into the stock by the continually decreasing distance between the cam plates. At about mid-stroke (Figure 6, bottom) the rolls run onto the flat portion of the cams and throughout the balance of the travel are no longer forced closer together.

The ironing does not begin at this point, however, because quite a little of the wedge left from the previous stroke has been advanced forward by the down-hill reduction and there is quite a wave of metal ahead of the rolls. This gradually disappears as the flat part of the stroke proceeds and just before the end of the stroke becomes a true ironing pass, rolling only by the spring in the main frame.

During all this time the gripping jaws have restrained the stock from being sucked into the pinch which is where the tension previously mentioned comes from.

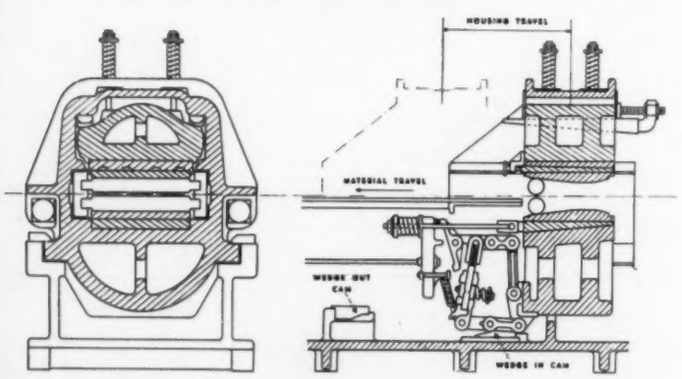
It should now be apparent that rolling power is applied to the rolls by frictional contact only, and that the rolls are free to find their own position governed only by the contacts, one on the cam plate, the other on the stock. The cam plates travel 36 in., the rolls about 18 in.; 9 in. of the roll travel is down-hill and about 6 in. is on the flat.

While the drawing of these schematic views is exaggerated for the sake of clarity, it should be also apparent that the rolls are cradled in a V-block, and hence can be made rather small in diameter without danger of distortion. This will prove of great advantage in rolling refractory metals such as silicon bronze and stainless or transformer steels.

The detailed construction of the rolling head is shown in section in Figure 7. This shows the main frame which resists the separating force riding on the lower pair of ways in the bed. The ways within the head at the pass line guide the roll carriage which, as was seen in Figure 6, travels only 18 in., while the rolling head travels 36 in.

The roll carriage keeps the rolls parallel to themselves and at right angles to the rolling, and is used to position the rolls relative to the cam plates when the rolls are out of contact with the stock on the return stroke. The

Figure 7 — Sketch showing the detailed construction of the reciprocating rolling housing.



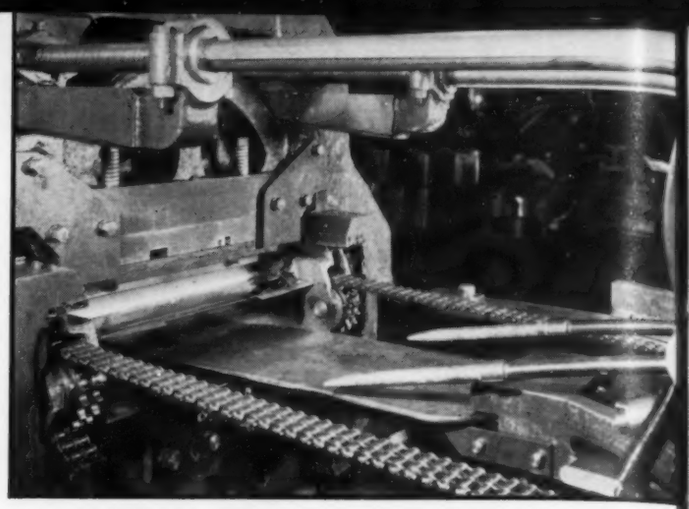


Figure 8 — The reduction made on the slab is clearly visible in this view of the entry side of the mill.

ends of the rolls are necked down and ride in small rectangular bronze bearings. The bearings are free to float up and down in vertical slots in the roll carriage and carry small counterbalance springs which keep the rolls spread apart and in contact with the cam plates.

Gage is controlled by moving the cap with the upper cam plate by means of two wedges. Screws with a splined extension slide in stationary quills which can be turned by the handwheel at the operator's position. One wedge or both simultaneously can be engaged by the wheel after the usual fashion for screwdowns, and overall or side to side correction made while the rolling is in progress. Because the mill is unloaded on each return stroke, the gage adjustment can be of relatively light construction as compared with the usual motor driven type and is easily turned by hand.

A second wedge adjustment is provided for crowning. Four independently adjustable wedges lie between the upper cam plate and the cap. These can be used to warp the upper cam plate and in effect take the place of the usual cambering of the work rolls. Hence camber can be adjusted to the particular job without the necessity of having a large number of roll pairs, all of different degree of crown. In actual practice it has been found desirable to use some crown in the rolls themselves and only subtract or add a differential amount to get exactly what is needed by these warping wedges.

The bottom wedge shown in Figure 7 is a full width one used to provide relief on the return or idle stroke.

The toggle and the "wedge-out" cam pull the wedge out and drop the lower cam plate at the end of the working stroke, and the cam plate stays down in the clear all the way back until it is again put into position by the "wedge-in" cam, ready for the next working stroke. The relief is necessary to clear the continuous in-feed of the stock so that there is no rolling up-hill under compression. Once a new bar of stock is well started and the reduced strip is out in the clear, this wedge relief action is stopped and the necessary clearance provided by phasing the roll return movement.

Mention has been made that the roll carriage positions the rolls except when they are actually on the pinch. This control is exerted by the mechanism shown in Figure 8. A pair of chains has one end attached to the fixed frame and one end to the moving rolling head.

The loop of the chain is carried around idler sprockets fastened to the roll carriage. Now, whenever the head moves, the roll carriage must move, but with only ½ the speed or the displacement of the head. Thus these chains insure that the rolls are always in phase with the head and the cam plates.

When, at the beginning of the working stroke, we wish to have the rolls free to find their own position on the pinch, the stationary end of the chains is loosened. This loosening shows to better advantage in Figure 9. In the top view, showing the start of the working stroke, the rolls are in phase with the cam plates and the chains are taut and give the half motion. After the pinch is made, the rock shaft loosens the chains and the rolls can follow their own devices on the way down the reduction. At the end of the stroke the slack of the chains has just about been used up, because the rolls tend to run a little ahead of the half way mark from stock extrusion and normal roll slippage. What slack remains when the rolls run into the clear at the end of the stroke is now taken up by the air springs and the chains are again taut, but with the rolls well ahead of the true half position.

The out-of-phase relation is maintained throughout the return stroke, keeping the rolls out of the vee between the cam and the reduction wedge on the stock. Phase is restored by rocking the bell crank back to initial position at the end of the idle stroke.

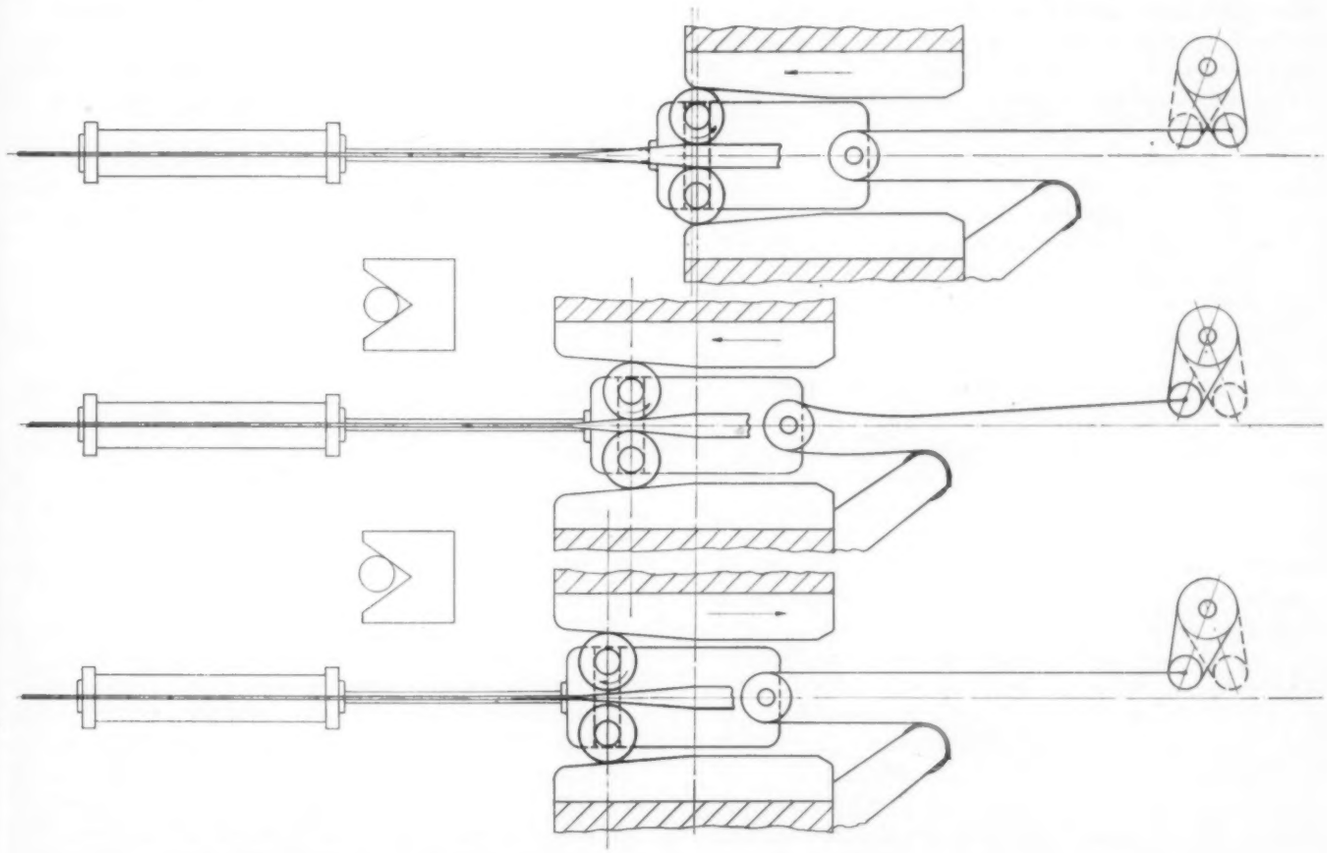
The idle stroke is not altogether idle. While it is possible to provide clearance by phasing the roll out of the vee, there is no vee when the roll is on the flat par of the cam. There is a little planish rolling, therefore, on the return stroke which adds its bit to the total reduction and helps to smooth out gage. This cannot be tolerated at the beginning of a new slab because the back rolling will ruffle up the thin strip and cobble. During this period the relief wedge must operate, so that there is no interference on any part of the return trip, but just as soon as enough strip has emerged to clear the rolls well, the wedge relief can be dispensed with and the rolling done by roll phasing alone.

The foregoing has probably given a fair idea of the general configuration of the mill and some of the action of the pinch point as it travels down-hill and along the flat. The similarity of the new cam plates to the backing rolls of the usual four-high and how the rolling power is developed by tension in the strip has been noted.

Each short bite is subject to the same limitations of pass design as would control in ordinary rolling. But, because we have rolled down a wedge and have done all degrees of reduction from soft to hard in one pass, we have in effect set aside these limitations and have obtained a tremendous reduction in one trip through the machine.

As you can see, there is no theoretical limit to the degree of reduction. The practical limit is what the metal can take without disintegration. Reductions of 90 to 95 per cent are not at all difficult, even on metals which work harden rather rapidly. These percentage reductions are visualized a little better if expressed as

Figure 9 — These sketches show the positioning of the rollers during the working stroke and the return stroke.



elongations, such as 10 to 1, 20 to 1, 30 to 1, etc. In other words, a slab of brass or steel which goes in ½ in. thick and emerges at .025 suffers a 95 per cent reduction and is elongated twenty times in its passage.

Several factors in the Krause design are favorable to high reduction without spoiling the metal. The small work rolls with their small contact area and minimum of scuffing is one obvious factor. Again, the high back-tension helps the reduction as much or more by stretching as does the compression from the rolls. And lastly, what appeals as particularly effective is the fact that all degrees of rolling, from thick-soft to thin-hard, are done continuously. The metal, so to speak, is pushed off balance, and never allowed to stop and recover until it is carried all the way down.

Only the one design of mill is available at present. Its size has been fitted to the requirements of the brass and copper industry where a stocking width of 25 in. (24 in. finish trimmed) and starting gages between ½ in. and 1 in. thick are dictated. The following specifications have been chosen to suit these conditions:

Rolls, 4 in. in diameter x 28 in. long.
Stroke of rolling head, maximum 36 in.
Separating force, 500,000 lb
Crank rpm, maximum 100
Maximum input thickness, 1 in.
Minimum economical delivery gage, .010 in.
Attached horsepower, 500

One commercial installation is driven by a synchronous motor at a fixed speed of 62 rpm. At the other, the drive is d-c which can be varied between 40 and 120 rpm. Not enough experience has yet been gained to show the advantage of the one type of drive over the other.

Because the rate of rolling is not too high, the writer's opinion is that the mill will be eventually run at a fixed speed determined by the reciprocating inertia conditions, and that the added expense of variable speed control will not be needed, although this addition is going to prove highly desirable during the experimental stage. This guess is based on the fact that the mill attains thermal equilibrium rather quickly after rolling is started. There is no great mass of metal to absorb the rolling heat slowly and there seems ample time on the back or idle stroke to wipe off the heat from the previous working stroke. Thus there is no sustained heat build-up and little necessity to make end-to-end gage correction as the strip proceeds through the mill.

It will be important to run the mill as fast as possible because speed is one of the factors which will determine the poundage produced per hour. The mill can deliver a maximum of 5 in. of strip per stroke, regardless of input or delivery gage. Hence, the production is directly proportional to speed.

Poundage is also proportional to delivered gage and strip width. The maximum delivery rate is 5 x 80 = 400 in. per minute, or 33 fpm, when the mill is turning at 80 rpm. If, at the same time, the strip width is 21 in. and .050 in. thick, about 420 cubic inches of metal will leave the mill each minute of operation. In brass this would be at the rate of 7500 lb per hour.

By the same token, the same amount must be fed to the mill. If the reduction is from a 1 in. thick slab, the feed would be 1/20 of the delivery, or 20 in. per minute; if from a ½ in. slab, the 10 to 1 reduction would require 40 in. per minute. If the feed be cut below these values it would simply mean that proportionately less would be delivered, without changing either the screwdown setting or the mill speed.

A question often asked about the mill is in the feeds and entry gages just mentioned. It seems a little paradoxical, when a given reduction is made from a 1 in. slab, to find that it takes no more power than when the same reduction is made from ½ in., and the query comes up. But the reason is easily apparent when considered from the feed end. The thick slab is fed half as fast as the lesser one and the same volume of metal is reduced per minute for either condition. Because there is no great change in the area of bite or cover between the two cases, there is nothing to require an increase of power for the heavier gage.

Some hint of the production possibilities has already been given in the mention of speeds and feeds and the description of the machine. Some new developments now under way will increase both production and operating economy.

The bench method of feeding individual slabs is faulty on several counts for strip production. At the time the first two mills were built, it was the best method available, but it was recognized that rolling time would be lost each time the mill was stopped for reloading, and that the scrap loss from the thick stub end in the gripper jaws would represent a definite and costly subtraction from the savings that could come from the rolling itself.

Of course, both rolling efficiency and scrap loss could be improved by the use of long slabs, but unfortunately these are not to be had in the brass industry. They are accustomed to cast about 5 to 6 ft long and around 2 in. thick, and by the time such slabs are broken down and overhauled they are still pretty short, running from 11 to 27 ft long. Such lengths are not sufficient to give the best possible rolling efficiency and the scrap is too high.

The obvious solution is to weld the slabs together and feed continuously. The brass industry has been attempting to weld strip for some time past, but without conspicuous success. When they fill orders requiring a strip length greater than 35 pounds per inch of width, it is usually done by brazing or silver soldering several coils together. This is done at finish or ready finish gages.

The bulk of their mill equipment is designed for the normal coil weight of 500 to 800 pounds and is not adapted to handle the bigger brazed package. Hence the brazing is done at thin gage and the minimum number of mills, annealing furnaces, slitters, etc. made oversize for the extra long coil. Accordingly, attempts at welding have been focussed on the same thin gage range.

When the Krause mill came into the picture, it brought along the idea of welding thick sections. We tried this and the results were immediately encouraging. It was not very long before the experimental work had brought the technique to the point where 6 square inches of section could be joined with perfect homogenity. And, when the section was rolled down, we had brass equal to the parent metal by any test. How this is accomplished is best described by a view of an experimental welder which is now under construction

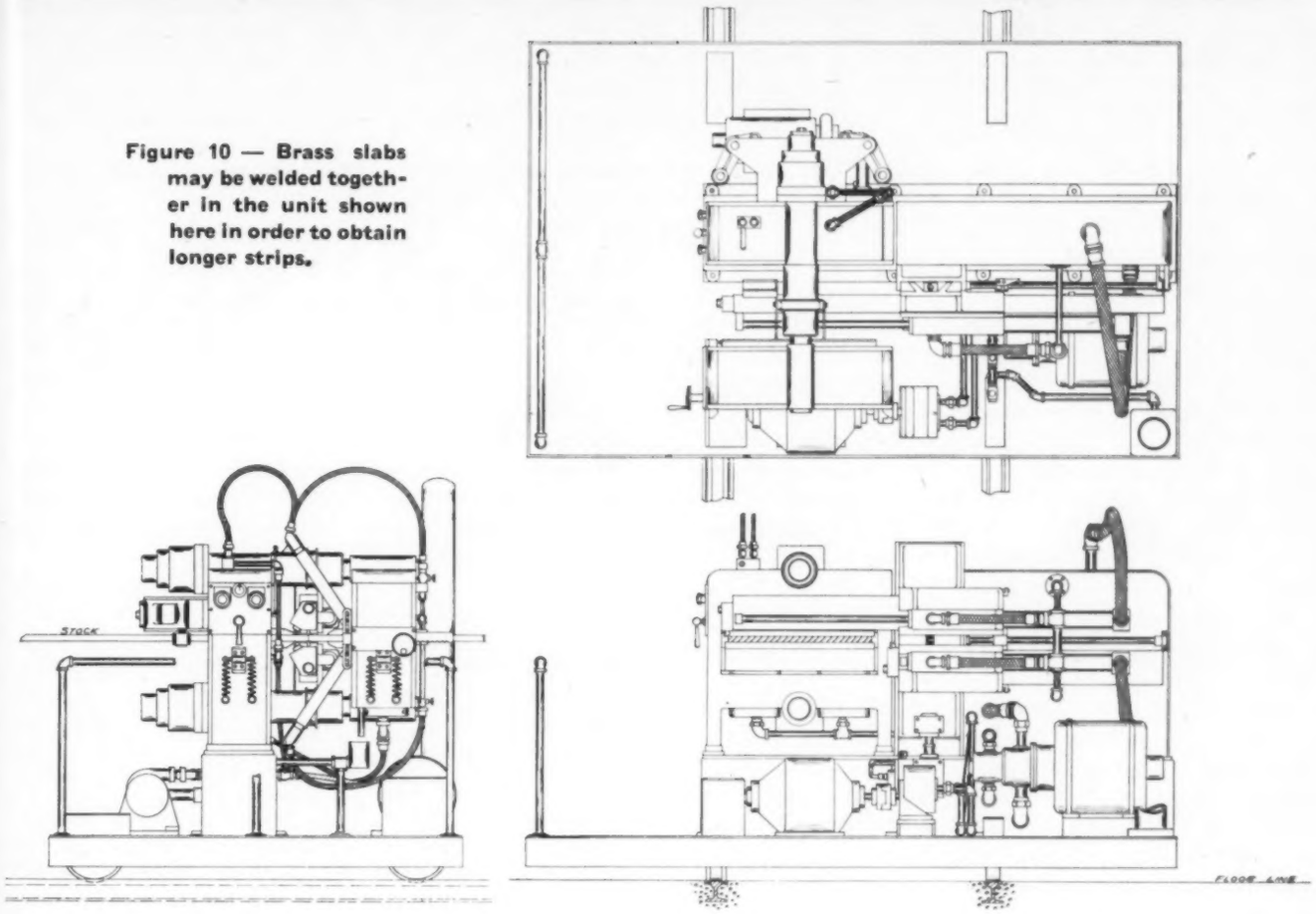


Figure 10 — Brass slabs may be welded together in the unit shown here in order to obtain longer strips.

(Figure 10). Two pairs of flat gripping jaws with heavy hydraulic clamps engage the two slabs to be joined. One pair is fixed solidly to the wheeled under-carriage, while the other pair is movable on ways so that it may be pulled toward the fixed jaws with considerable hydraulic pressure.

The two rough sheared slabs are placed butt to butt and clamped in line with one another. The two rough butts are now planed to a machined finish by a pair of parting tools in two reciprocating shaper rams above and below the rough joint. At the conclusion of this shaping the two slab ends are now square, parallel, and exactly matched, and can be moved together to form a nicely closed joint, by introducing a moderate hydraulic pressure in the forging cylinders attached to the movable clamp.

With the joint tightly sealed, two long oxyacetylene burners are swung down in line, ignited and the flames played on either face of the joined slabs. The brass is quickly brought up to forging temperature, and when it has reached a mushy state, the sealing pressure starts a small upset. The corresponding movement of the jaws trips a valve which throws the full forging pressure on the joint and completes the upset and the weld.

The shaper rams are now brought into action a second time to sweep off the upset which results from the weld, and brings the slab down again to the initial thickness. The rams are fitted with turret heads carrying both the parting tools previously used and the broader scarfing tool for the upset removal. This completes the cycle and requires a time of about 4 minutes for the entire procedure.

It has been asked often why the weld ng is to be done by oxyacetylene rather than by the usual electrical welding method. There is no reason except the major one of economics. A perfectly satisfactory weld can be made by a resistance setup, but the power input would go as high as 8000 kva for a practical slab cross section, and very few power installations could accept this high intermittent load without expensive additions far beyond the cost of the gas installation. Flash welding, with its much lower electrical demand, does not give good results with the high thermal conductivity of brass and copper.

Now let us see how the welder just described matches up with Krause mill, and how the two fit into the second development of a complete reduction line. Such a system is shown schematically in Figure 11. On the upper right is a slab storage rigged with handling equipment to place one slab at a time on the roller table leading to the welder.

The welder is on rails between the loading position and the continuous feeder to the mill, and travels toward the mill steadily while a weld is made. When the weld is finished, the gripping jaws are released and the welder motored back to the loading bench. As the outboard end of the slab registers with the jaws, a fresh grip is taken and the slow travel toward the mill is again begun. A second slab is now rolled forward into abut-

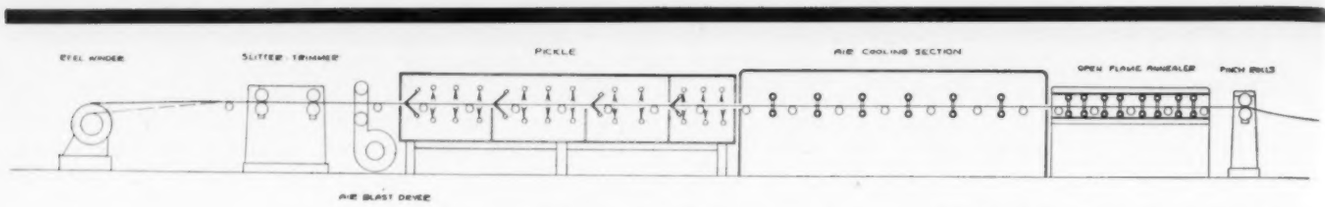


Figure 11 — Schematic arrangement of continuous production line

ment with the moving strip, clamped, and a second weld performed.

This action is repeated with the mill accepting stock continuously. There is sufficient time between slabs of the length and weight usually encountered for the welder to perform its cycle and return to reload, thus permitting the mill to run at maximum capacity.

The mill proper, at the upper left, is equipped with pinch rolls instead of a reel. These rolls deliver the intermittent output into a slack or sag-loop from which a steady feed to the succeeding equipment is taken.

This secondary equipment can be of any sort adapted to further processing of the reduced strip. In the case illustrated for brass or copper, there is an annealer and a pickling unit in line. Capacities up to 10,000 lb per hr can be encompassed within reasonable space limitations, by the use of open flame annealing. Air cooling of the annealed strip is used before water quenching to prevent wrinkling or bellying of the strip. An edge trimmer or slitter and wind-up reel complete the line.

Present development plans contemplate a unit reduction system of the sort just described to be contained within a space 20 feet wide and 175 feet long, handling strip widths up to 25 inches in coils weighing 7500 lb or less at a maximum net rate of 10,000 lb per hr.

At the start of this paper it was mentioned that once in a while a new idea came along that fitted exactly into the jig-saw puzzle and provided the answer. We believe that this complete reduction system is going to be the answer to such a problem in the brass and copper industry. For a long time they have looked enviously at the big steel plants and have wished they too could realize some of the economy that accrues from working long coils continuously. They got a taste of what could be accomplished when they built the several big ammunition strip mills for the war. These were designed for a heavy unit package (2200 lb) and were pretty generally streamlined. The ratio between pounds per man-hour by the regular procedure and by the new government layout is so high that it left little doubt about the importance of the handling factor in their costs. But the big package is out of the question in ordinary times. They are essentially a jobbing business and the average order is usually about 800 pounds.

Until recently most orders were jobbed all the way from the cast shop. A slab, or at most a few slabs, of proper width to trim at finished gage to the order width, would be cast in adjustable width molds and handled all the way to the shipping room as a separate job. Cast widths generally ran from 8 to 14 or 15 inches and a good sized bar was 400 pounds.

The past several years has seen a change. The tendency now is to cast wider widths for stock, say 20 to 24 in., and to run down in bigger quantities to several stock gages. With this system, orders are referred to the stock pile instead of the cast shop, and jobbing is started farther down the line. Some economy has resulted, but the coils are still short and there is still the necessity for frequent handling at the mills and to and from the annealers and cleaners.

There is considerable demand for coils longer than the usual 30 to 40 lb per inch of width. Metallic hose makers, press operators making electric lamp base sockets, radiator core tube machines, etc. would be benefited by coil lengths of 250 lb or more — even to 400 lb — per inch of width.

In the complete line just described, the welder takes care of the length without upsetting standard cast shop technique, giving a package of sufficient size, say 7500 lb or thereabout, and making it possible to do secondary rundown economically on a reversing type tension mill.

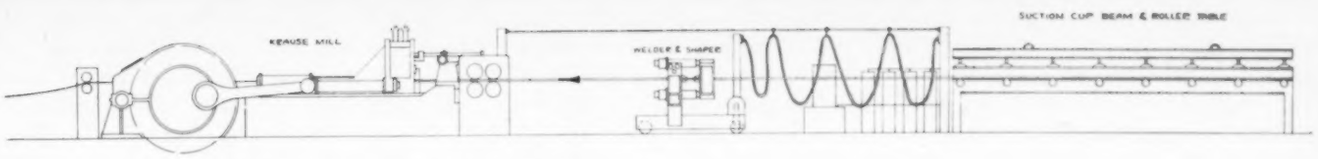
The Krause mill and the combined annealing and cleaning share honors in eliminating the bulk of the costly item of handling. Five men in attendance on the line, in one continuous operation, can produce from 5,000 to 10,000 lb per hr of stock gage. These poundages, in a 500 hour month, give monthly production totals of from 2,500,000 lb to 5,000,000 lb, which is just about what the average brass strip mill produces.

With a saving of a fraction of a cent per pound, such tonnage can be expected to reduce costs in the rundown range by $90,000 to $180,000 annually, which stacks up well against an equipment cost (installed) of less than $250,000. Such figures are interesting even in these times of high tax rates which discourage investment for the sake of cost improvement only.

Whether or not the complete reduction line can be put to work economically in the secondary rundown range remains to be seen. The first pass through the mill to stock gage is definitely attractive. A second pass, running, say from .100 in. gage to .010 in., shows such low poundage that present method costs are comparable and an estimated comparison unreliable.

Such comparisons cannot be taken generally. They are specifically based on a limited knowledge of costs in brass. They would change with different methods of figuring burden, because with only five men running the line it is evident that the main items are overhead and indirect costs, with direct labor only a small fraction of the total. They would also change with material run. We have reason to believe, for instance, that high carbon razor blade stock can be carried economically to .008 or .009 in. Every case will have to be figured on its merits, and so far all that can be mentioned with much assurance are brass and copper.

The only generalization which can be made is this. Wherever a reduction of 10 or 20 to 1 is now made and



including welder, cold mill, annealer, pickler, slitter and reel.

is attended with a great deal of handling, it will be worth while to study this system as a reduction and processing means.

One more thing will be touched on briefly. The metal from the Krause mill is not ordinary. It has little undistributed strain and will slit without much fanning. But it is very definitely over-rolled and exhibits directional properties, which is bad. Bad, that is, for certain classes of work such as deep drawing. Polarized metal does not draw uniformly, and cups show little ears around the open end after coming through the die.

The antidote for this was already on the shelf and waiting. Earl Palmer and Cyril Smith of American Brass Company, in a fine research on the correction of directional metal, had discovered that polarization can be removed by a high anneal, followed by a normal rolling and a normal anneal. Applied to the complete reduction line, it simply means that the furnace, instead of being set for a normal anneal, around 1100-1150 F, will be pushed up to 1375 F. Then, when the metal is given a further 50 per cent reduction and a regular anneal, it will again be satisfactory for any of the customary services.

While it has been possible to cover only one phase of the many interesting applications of the Krause mill in this paper, it is readily adaptable to some trickier processing of metals and alloys other than brass and copper.

DISCUSSION

PRESENTED BY

F. R. KRAUSE, Consulting Engineer, Blaw-Knox Company, Pittsburgh, Pennsylvania

W. TRINKS, Projects Director, American Society of Mechanical Engineers, Pittsburgh, Pennsylvania

F. H. DYKE, Assistant General Manager, Wheeling Steel Corporation, Steubenville, Ohio

C. A. KRAL, Manager Tin Plate Division, Jones and Laughlin Steel Corporation, Aliquippa, Pennsylvania

M. D. STONE, Manager Development Department, United Engineering and Foundry Company, Pittsburgh, Pennsylvania

P. M. MUELLER, Chief Engineer in Charge of Developments, Blaw-Knox Company, Pittsburgh, Pennsylvania

B. C. McFADDEN, Chief Mechanical Engineer, Aluminum Company of America, Pittsburgh, Pennsylvania

G. C. FLOYD, Plant Manager, Allegheny Ludlum Steel Corporation, Brackenridge, Pennsylvania

H. F. VOIGT, Proposal Engineer, United Engineering and Foundry Company, Pittsburgh, Pennsylvania

J. S. MURRAY, Chief Electrical Engineer, Follansbee Steel Corporation, Follansbee, West Virginia

F. P. McCORMACK, Engineering Department, Crucible Steel Company of America, Pittsburgh, Pennsylvania

F. R. Krause: In my opinion this method of rolling has just as many possibilities and advantages in the steel industry as have been outlined in this paper for brass.

Although our experimental work to date in the ferrous field is not as far advanced as in brass and copper, we can visualize practical designs which will be capable of rolling from heavy gage billets, either hot or cold, to gages comparable to the usual tandem hot mill output. Such designs would be interesting to concerns who do not have such elaborate equipment, or it may be that they could fit into the bigger plants for special rush order work and thus improve service to the customer.

Hot rolling will make it possible to extend the degree of reduction far beyond the practical cold rolling limits which have been mentioned, and this should open up possibilities and applications which can only be guessed at now. We are only at the beginning of finding out what can be done and there is a great deal of work and experimentation ahead before we can say positively where the mill will fit into the steel industry best, but we are quite sure that there will be plenty of interest in the future.

W. Trinks: Before I became acquainted with the Krause mill, I had developed a reasonably complete theory of the ordinary rolling mill, and I flattered myself that I had rationalized rolling mill theory and design. But when Mr. Krause came along with his mill, I found that my rolling mill theory could not be applied to his mill. This means that whenever the pressure of war activities lets up, I shall have to sit down and try my best to work out a theory for the Krause mill. This is as it should be because practice always precedes theory, and we see today the Krause mill introduced into practice without a theory to fit it.

I visited Mr. Krause several times in Ellwood City for the purpose of observing the progress which he had made with his first experimental mill. I also visited him in Groveton where his second experimental mill was in operation. I gave Mr. Krause what little help I could and tried to encourage him, because I could see that his experimental mill had the germ of successful application in it.

I do not quite agree with Mr. Krause that his mill is to be used mainly in those places where no strip mill has been installed. It appears to me that his mill is just the thing to serve as supplementary equipment for large mills. It can fill small orders of sheets in various widths, thicknesses and composition of metal. I can see in the future large plants installing one or two electric furnaces and a Krause mill. This combination will permit successful and economic production of small orders, or of orders of odd composition of metals.

F. H. Dyke: I have little to say about this Krause mill, because it has been covered so thoroughly. I think Mr. Mueller's opening statements covered the ground pretty thoroughly when he said that this mill was capable of reducing any metal which could be cold reduced. That opens up a tremendous picture, particularly for some of our steel alloys which are hard to cold roll and I think if we let our imaginations run more or less wild, we can see a tremendous possibility for development of this kind.

C. A. Kral: I feel more or less like Professor Trinks. For some time, we have fooled our friends and superiors about the art and mysteries of the four-high mills and about the time we have that accomplished, Mr. Krause invents a mill with an entirely new theory. Mr. Mueller has given us a very clear and understandable picture of this mill. It surely is an extraordinary mill, and while the remarks we have heard dwell upon copper and brass, I believe it will lend itself to the rolling of electric sheets and could well be an auxiliary to our large strip mills to roll the extreme light base weights and particularly, the more difficult grades of steel of light base weights that we are going to see after the war among the tin mill products. This would relieve the high speed tandem mills for greater production.

M. D. Stone: I should like to ask Mr. Mueller if he can explain why it is at the present time in the brass industry that they conventionally limit cold reductions to 50 per cent, followed by a subsequent anneal and pickle and then another reduction, etc. Is it a matter of limitation due to mill design or are the objections metallurgical?

P. M. Mueller: I do not believe that it is a matter of equipment design, because you can take ordinary brass strip and roll it down through a very large reduction on a normal two-high mill, provided you take enough time to do it.

The practice of only going 50 per cent between anneals is old and well established, and probably hasn't been sufficiently criticized and corrected. It stems from the fact that if good deep drawing quality is wanted, the amount of reduction between anneals must be limited. With 55 or 60 per cent reductions one begins to get into trouble with directional properties.

The research work I mentioned, by Palmer and Smith, where they can correct for over-rolling by an abnormal anneal and proper subsequent processing, is comparatively recent and is not yet too well known to the industry. If this takes hold and works out well in general practice, I think that much rolling now done on the 50 per cent basis will be eliminated.

B. C. McFadden: I feel about the same way as the men from the steel industry. The Krause Mill has some very attractive features which so far have not been definitely proven. Our experience in reducing some aluminum alloy slabs at the Lewis Foundry and Machine plant about 4 or 5 years ago indicated good gage uniformity but with some unexplainable buckling. I feel that this mill may eventually have a definite place in the rolling of aluminum, probably in a plant that cannot afford a continuous mill. The economy of rolling small orders on a mill of this kind may be one of its determining features. I will be very much interested in the future development of this mill.

G. C. Floyd: As the stainless steel business is particularly a business of small orders, we are constantly confronted with orders as small as 10 to 50 lb. This type of mill, although it seems very slow to a producer of carbon steel, would fit in well with the production of small quantities of stainless steel strip.

Several years ago we took samples to Groveton for cold rolling on the Krause mill. These samples, I believe, were approximately $\frac{1}{8}$ in. thick and were cold reduced to .008 in. in one pass. Because of the cold working property of 18-8 steel, we produced strip which had a tensile of well over 200,000 psi. As these experiments were performed on an experimental mill, there were many difficulties to overcome, such as gage variation from end to end of the strip and the corrugated effect produced by each bite of the mill, but from this paper I learn that most of these difficulties have now been eliminated.

As the producers of stainless steel strip are looking more and more toward the high tensile fields and as the high tensile properties of chrome-nickel stainless alloys are developed through heavy cold reductions, we believe this mill might be particularly well adapted for high tensile production.

H. F. Voigt: I would like to ask about pressure. What does it mean when the pressure is over that half million pound separating force? Do the cam plates become larger, and what are the cam plates made of?

P. M. Mueller: The rolling head of the machine, the part which corresponds to a four-high mill, is designed to resist a separating force of 500,000 lb. This means that the design of any pass to be taken on the mill must be so regulated that the pressure of the rolls on the strip will not exceed this amount.

The present cam plates are made of deep-hardening ball-bearing steel such as SAE-52100. With oil quenching we have not attained as high hardness as is desirable, but now materials are being tried where we can get scleroscope of about 85. As soon as a machine is available for grinding the tricky contour efficiently, we will be able to use a high strength, high hardness cast alloy which will be cheaper and much easier to handle than the ball bearing steel.

J. S. Murray: I would like to know if there is any serious fluctuation in the power input to a mill of this kind. Mention was made that there were some synchronous motors used in driving it.

I would like to know also what is the present maximum size limit, if any, on the mill, and if it can be used to roll dissimilar metals, such as clad metals, copper and steel or other metals and steel.

P. M. Mueller: We have recently had instantaneous power readings taken on the Hussey mill, but the complete analysis of these is not yet available. As you can

(*Please turn to page 57*)

DETERMINATION OF DUST IN *Blast Furnace Gas*

. . . . this new method, using sugar as a filtration medium, was developed to eliminate difficulties encountered in the standard thimble method . . . .

by D. G. HISLEY

COMBUSTION ENGINEER

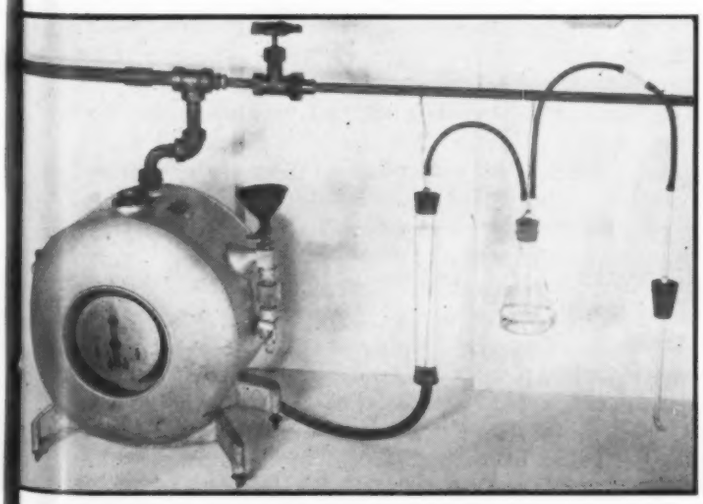
COKE OVENS AND BLAST FURNACES

BETHLEHEM STEEL COMPANY

SPARROWS POINT, MARYLAND

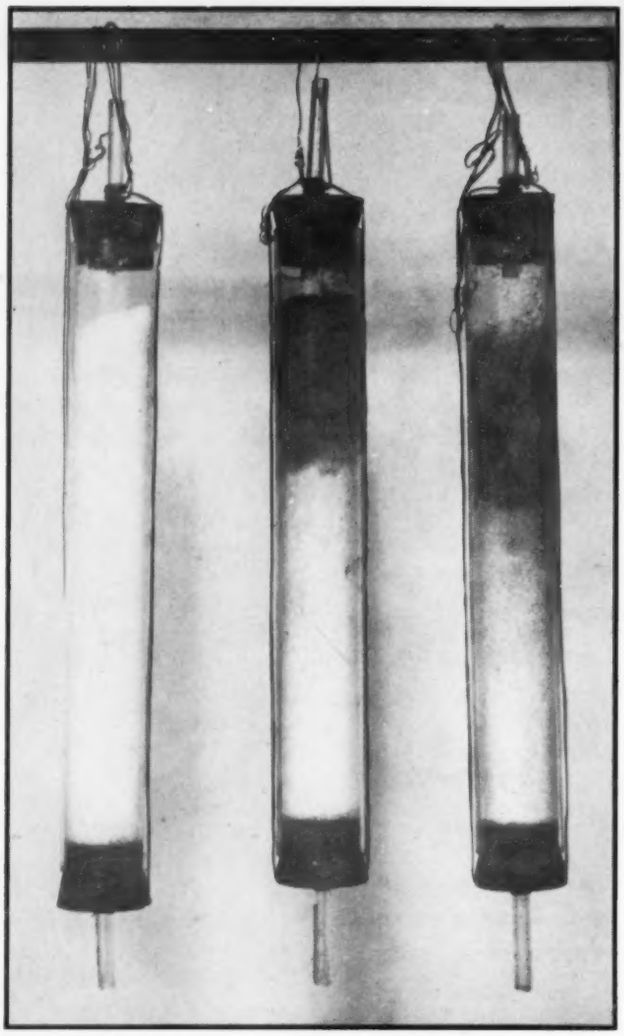
▲ THE sugar method to determine the quantity of dust in blast furnace gas was developed at the Sparrows Point plant of Bethlehem Steel Company to replace the standard thimble method. The thimble method was discarded because our primary cleaned gas is washed with water containing 350 to 400 grains of NaCl per gallon, and when taking a gas sample, the thimble collected NaCl from the moisture in the gas, thereby giving inaccurate results. Only small quantities of gas could be sampled before the thimble became clogged with NaCl Also, to keep the thimble from rupturing due to its absorbing moisture while the gas sample was being taken, it was necessary to heat it with electricity to a temperature of 215 F. It was difficult to maintain this temperature without overheating. It was also difficult to obtain accurate thimble weights due to the thimble absorbing moisture while on the scales.

Figure 1 — Sampling equipment. (1) Sampling tube. (2) Erlenmyer flask. (3) Sugar tube. (4) Gas meter. (5) Eductor siphon.



Basically, the equipment used in the new method consists of a glass sampling tube, a 300 cc Erlenmyer flask containing 25 cc of distilled water, a 1½ in. x 8 in. glass tube filled with sugar, a gas meter, an eductor siphon and rubber connecting tubing (see Figure 1). The sampling tube is equipped with stopper to hold tube in place while sample is being taken. The Erlenmyer flask catches large particles of dust and some of the entrained moisture in the gas sample. Rubber tubing connecting the equipment is in short sections connected to each other by glass tubing. This makes this part of equipment easy to wash.

Presented before A. I. S. E. Philadelphia District Section, February 3, 1945.



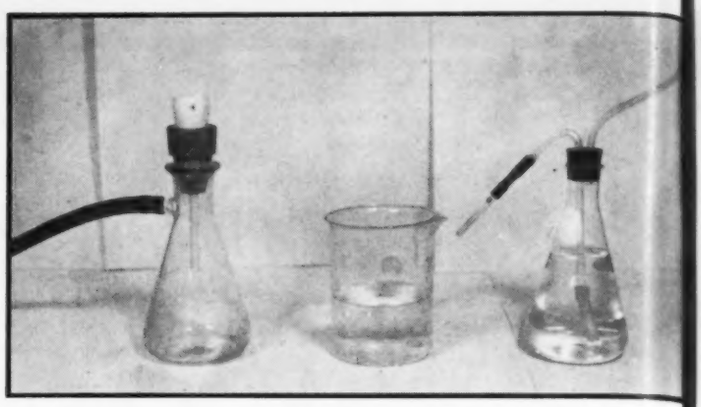


Figure 2 — Examples of sugar tube at various stages of sampling. (1) Start. (2) At half way point. (3) At end of sampling. (left)

▲

Figure 3 — Washing and filtering equipment. (1) Vacuum flask with Gooch crucible. (2) 600 cc beaker. (3) Wash bottle with distilled water. (right)

The sampling tube is placed in the gas main so that its tip will be at a point of the mean velocity of the gas flow, with its opening toward the upstream flow of the gas. ("Technical Gas and Fuel Analysis," by Alfred H. White.) Simultaneously with the insertion of the sampling tube into the gas main, a suction is applied to the outgoing end of the meter. This draws the gas through the sampling tube, Erlenmyer flask, sugar filled tube and meter, and then out through the eductor siphon. The velocity of the gas through the sampling tube tip is maintained at the same rate as the velocity in the main from which the sample is being taken by controlling the rate of gas flow through the gas meter. This rate is controlled by regulating the air to the eductor siphon.

The volume of gas that may be sampled varies with the quantity of dust and moisture in the sample. As the sample is being taken, the sugar in the sampling tube will begin to dissolve and discolor. This action will take place first at the top of the tube and gradually work toward the bottom (Figure 2). When the sugar begins to discolor and dissolve near the bottom of the sugar tube, the sampling tube is withdrawn and the gas meter stopped simultaneously. During the test, the following data is taken to correct the volume of gas sampled to standard conditions:

1. Pressure of gas in the meter.
2. Temperature of gas in the meter.
3. Barometric pressure.
4. Cubic feet of gas sampled.

After the sample has been taken, the sampling tube, flask, sugar filled tube, and all connecting tubes are taken to the laboratory to be washed. The equipment, starting with the sampling tube, is dismantled piece by piece, and washed out thoroughly with warm distilled water into a 600 cc beaker. Each piece of connecting tubing must be thoroughly cleaned. A glass rod should be run back and forth through the tubing while washing to remove all collected dust. The flask is then emptied into the beaker and washed out thoroughly, followed by the tube containing the sugar. When the washing is completed, the entire contents of the beaker is ready to be filtered through a Gooch crucible provided with an asbestos filtering pad.

The beaker containing the water and dust obtained by washing the equipment is usually allowed to stand for eight hours or longer. This permits the dust to settle to the bottom of the beaker. Approximately 90 per cent of the dust will settle out.

The Gooch crucible, prior to filtering the sample, should be dried at 105 C, cooled and weighed. A Gooch crucible, being made of glazed porcelain will not absorb moisture while on the scales. To save time in filtering, the top layer of clear water in the beaker should be put through the Gooch crucible first and the bottom layer of dirty water last. When the beaker has been emptied, it should be thoroughly washed with warm distilled water. This water is also filtered through the Gooch crucible. When the filtering process is complete, the crucible should be washed several times to dissolve any sugar that may be embedded in the asbestos filter pad. The crucible should then be dried at 105 C, cooled and again weighed. The difference in weight before and after filtration is the weight of the dust collected. The weight of the dust weighed at the laboratory is reported in grams. The grams should be converted to grains and the result reported as grains of dust per cubic feet of gas.

DISCUSSION

PRESENTED BY

J. F. ORAM, Combustion Engineer, Bethlehem Steel Company, Steelton, Pennsylvania

R. W. STANFORD, Combustion Engineer, Bethlehem Steel Company, Steelton, Pennsylvania

M. J. BRADLEY, Field Engineer, Leeds and Northrup Company, Philadelphia, Pennsylvania

B. M. LARSEN, Physical Chemist, United States Steel Corporation, Kearney, New Jersey

M. J CONWAY, Manager, Petroleum Division, Lukens Steel Company, Coatesville, Pennsylvania

W. N. HORKO, Engineering Department, Henry Disston & Sons, Inc., Philadelphia, Pennsylvania

T. J. ATKINS, Precipitron Specialist, Westinghouse Electric Corporation, Philadelphia, Pennsylvania

D. G. HISLEY, Combustion Engineer, Coke Ovens and Blast Furnaces, Bethlehem Steel Company, Sparrows Point, Maryland

A. J. FISHER, Fuel Engineer, Bethlehem Steel Company, Sparrows Point, Maryland

J. F. Oram: We have been using the thimble method for determing the dust in blast furnace gas. We will admit the results may not be accurate but they are relative. We have been using it over a period of several years and have enough tests to know what grains per cubic foot give us good operation. As long as we can maintain good operation, that is all we can ask. For comparison purposes, it would be well if all plants would adopt one method and stick to it rather than have one method at one plant and another at another. The company or the industry should settle on a standard.

R. W. Stanford: I think the Sparrows Point plant has a condition which is peculiar to that plant. They sometimes use water for washing their blast furnace gas which becomes brackish, thus producing a large amount of sodium chloride contamination if the thimble method were used. We have a very low and constant salt content in our water and therefore feel, as Mr. Oram has stated, that the thimble method is reliable.

I would like to ask one question. Has any determination been made of moisture carry-over from your various washing equipment? If so, I would be interested in your methods.

M. J. Bradley: We are interested in removing solids (dust, smoke, and metal fumes) from waste gases for continuous gas analysis. We have never considered granulated sugar as a filtering medium because of the possibility of the water vapors dissolving the sugar. However, I should like to know roughly the amount or weight of the sugar used in the filtering tube and also the volume of blast furnace gas passed through the sugar for each test.

B. M. Larsen: We have used an old Bureau of Mines method for sampling both air and furnace gases; it is just the impinger plate method. You have a fixture holding a brass plate opposite the end of the glass tube shaped to form a jet, and you suck the gas through the jet and it impinges on the brass plate. That is, the bubbles impinge on the plate under water. We have sampled open hearth gases that way, also air and blast furnace gas, and if you put a second impinger bottle in series with the first, you usually do not get much dust in the second I wonder if this method might not be a still simpler way of doing the same thing. Apparently the idea is if the bubbles slam against the plate under water all the fine dust gets kicked out.

M. J. Conway: Mr. Bradley inquired about the quantity of sugar used in the tests and I, too, am interested in this information. It is evident, from the information submitted by Mr. Hisley, that a good deal of thought has been given to the problem of obtaining reliable dust content analysis, but it seems to me that further improvement may be possible by the use of powdered metal filters made of suitable alloys which would be immune to iron pick-up. I would like to know if such a medium has been tried and with what degree of success.

It seems to me that it would be possible to obtain a a suitable metallic filter that would collect the sample and simplify both the method of collecting and determining the dust content of the gases to be analyzed.

W. N. Horko: I would like to ask Mr. Hisley what was the reason for selecting sugar as the agent for collecting the dust particles?

T. J. Atkins: I would like to ask if you have used the electrostatic dust sampler and compared it with the thimble or sugar method?

D. G. Hisley: Concerning the accuracy of testing for dust by the thinble method, we have found it to be inaccurate because the dust which settles in the sampling tube is not accounted for. This was one reason for not using this method at Sparrows Point.

The amounts of gas that can be passed through a sugar sampling tube are 30 to 35 cu ft of cleaned gas from a disintegrator, 20 to 30 cu ft of gas from the exit of a tower washer, and 12 to 18 cu ft of gas from the main between the dust collector and tower washer.

The sampling tube holds about ½ lb of sugar. I do not know the reason for selecting sugar as the dust collecting agent. It has worked entirely satisfactorily for the purpose and is the only material we have used. Blank samples have never shown any appreciable quantity of dust which would cause erroneous results. At one time, salt was suggested for the collecting medium but it was not tried because we thought it would pack too tightly to permit a free flow of the gas.

With regard to the question on moisture tests, we have made some tests but because of the necessity of estimating the amount of dust entrapped with the water, we do not rely on their accuracy.

We have done no testing with either the Bureau of Mines method or the use of electrostatic dust precipitators.

A. J. Fisher: I would like to say something in defense of the sugar method. It is designed primarily for use on very clean gas. In sampling rough gas or very dirty gas, the thimble method may be all right for comparisons. However, when you have gas that contains .015 grains of dust per cu ft or less, you must have an accurate method of dust determination. The sugar method is accurate enough to show a differential between very clean gases.

UNUSUAL APPLICATIONS OF *Motor Control*

. . . . describing installations in actual service which may be of use in other applications . . . .

by P. B. HARWOOD
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▲ IT is the purpose of this paper to discuss some unusual applications of motor control, with the thought that perhaps some of the devices and circuits developed to solve these unusual problems may be found useful for other applications. The applications discussed, while they are unusual in that they have not been used very often, are not necessarily new, and all of them are in actual service.

INTERLOCKING FOR CRANE BRIDGES

Where two or more crane bridges are installed on the same runway there is the probability that they may run into each other. Several methods of preventing such collisions have been proposed, but most of them have some serious disadvantage. Limit switches operated by long arms or bumpers have been proposed, but the mechanical difficulties are obvious, and it would probably not be practical to make the operating arms long enough to stop the cranes when they were a safe distance apart. Photo-electric safety devices do not seem to have been successful, at least under the conditions of crane operation in steel mills.

The method shown in Figure 1 will safely interlock the bridges of three cranes, preventing any two from approaching too closely, yet permitting the bridges to be moved apart by normal operation of the master controllers. The limiting distance of approach may be anything that is desired. The method requires a set of sectionalized trolley rails or wires, and a total of only one control relay in addition to the normal bridge control.

In Figure 1, the master controllers shown are a part of those used for normal operation, and the relays UV1, UV2, and UV3 are the existing under-voltage relays of the bridge control panel. The additional relay is CR, which is an ordinary shunt relay having three normally open contacts. The coil of CR is connected across the power lines in series with a resistor. A connection is carried from the junction of coil and resistor, through trolley shoes, to the sectionalized trolley wires. Relay CR is mounted on crane number 2, the center crane.

On crane number 1, and also on crane number 3, a connection is carried through trolley shoes from line L1 to the sectionalized trolley wires. Now, if two of the cranes approach each other closely enough so that the trolley shoes of number 1 and 2, or of 3 and 2, move onto the same section of trolley wire, the coil of relay CR will be short circuited, and the relay will drop open. As soon as the shoes move away from the same rail section, the relay coil will again be energized and the relay will close.

Considering the control for crane number 1, it will be evident that the relay UV1 is closed when the operating master is in the off position and, in any position in the reverse direction, is maintained closed by a circuit through one of its own contacts. Crane 1 may therefore at any time move away from crane 2. In the forward direction, however, when moving toward crane 2, the maintaining circuit for UV1 goes through one of its

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own contacts to a trolley, and from the trolley through a contact of relay CR to line L1. So crane 1 can move toward crane 2 only when CR is closed.

In a similar manner, the circuits for relay UV3 of crane 3 are arranged so that crane 3 can move forward, or away from crane 2, at any time, but can move in the reverse direction, or toward crane 2, only when CR is closed.

Relay UV2 on crane 2 gets its circuit through relay CR in both directions of travel, and so may move toward either crane 1 or crane 3 only when CR is closed.

When cranes 1 and 2 approach each other closely enough so that the trolley shoes 1 and 2 move onto the same rail section, relay CR opens, dropping out relays UV1 and UV2, and stopping both cranes. The operator of crane 1 may then reverse his bridge and move away, when CR will reclose and both cranes are free to move as they please. With the sectionalized trolleys staggered as shown, the minimum distance of approach will be one half of the length of the trolley section.

This scheme would appear to be simple, positive, and safe. It requires very little apparatus, and that of a sturdy character. The relays are either fully energized or not energized at all, so that there is no question of variable operation because of coil heating, voltage fluctuations or variations in trolley shoe resistance.

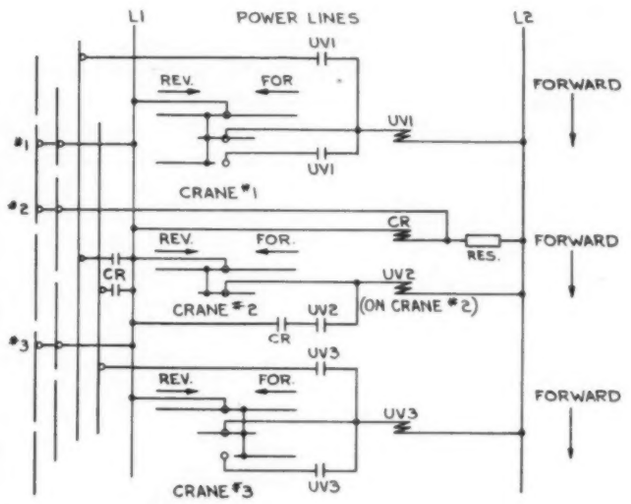

Figure 1 — Scheme of connections for interlocking three crane bridges.

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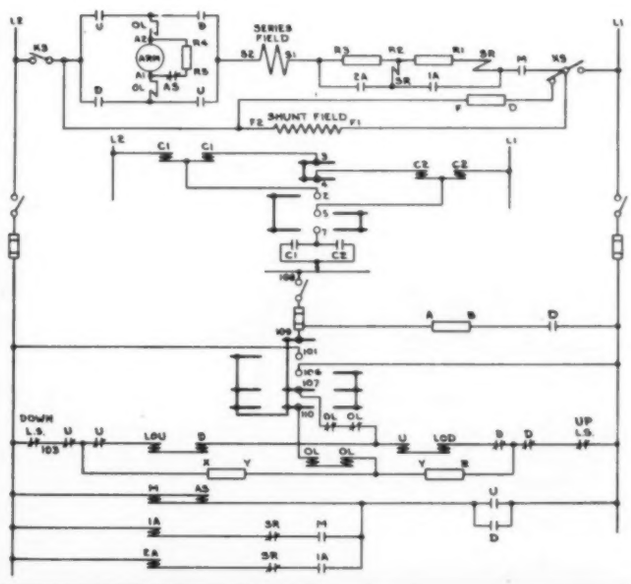
Figure 2 — Connections for furnace door control.



FURNACE DOOR CONTROL

The furnace door control shown in Figure 2 is an example of the possibility of obtaining a number of control functions over a single trolley wire. This installation consisted of a long row of furnaces, each having a door equipped with a motor to raise and lower it, and with magnetically operated control for each motor located near the door. A control master for each door was also located at the furnace. The battery of furnaces was served by a crane which ran along in front of the furnaces and it was desired to have a master controller in the crane cab from which any door might be opened or closed. Each furnace had a short section of trolley rail in front of it, and the crane was equipped with a trolley shoe which made contact with the rail of the particular furnace in front of which the crane was standing. Through this single trolley connection it was desired to be able to raise or lower the door. It was also desired to be able to reset the overload relays of the control panel and to be able to obtain low voltage protection. A further requirement was that the operator might move his master to the raise position, raise one door, and then run the crane down the row of furnaces without raising any other doors, although the door master remained in the raise position. Still another requirement was that once the operator started a door down, he might move the crane away but the door would continue to close. All of these functions were secured over a single trolley wire.

The main circuits of Figure 2 are those of a conventional reversing magnetic controller having two steps of acceleration controlled by series relays and equipped with an armature shunt circuit. There is nothing unusual about this circuit except that the series coils of the overload relays, which normally are connected directly after the knife switch, are here connected next to the armature and so are reversed with the armature. The reason for this will appear later.

In the crane cab there is the master controller having circuits 2, 3, 4, 5, and 7, and there are the two relays C1 and C2. All of the rest of the control is on the ground and is duplicated for each furnace door. The single trolley connection is between the contacts of relays C1 and C2, and the trolley wire at point 108.

The reversing contactors U and D have closing coils, also marked U and D, and holdout coils, marked LOU and LOD. They each also have a double set of normally closed interlock contacts. The four coils are connected in series across the line, the circuit including the normally closed interlocks and the final stop limit switches on the door. The pull of the holdout coils is relatively very strong, so that neither U nor D will close regardless of the value of the line voltage impressed on the circuit. In operating from the ground, to raise the door,

the ground master is moved in a direction to connect points 101 and 107. A circuit is then obtained from line L2, through the contacts of the overload relays, to the mid-point of coils U and D. The circuit containing coils D and LOU is now short circuited and these coils are ineffective. Coils U and LOD, however, are energized on full voltage. Contactor U closes and contactor D is even more definitely locked out. The door is raised until the master is moved off, or until the door is stopped by the opening of the up-direction limit switch. Contactor U then opens to stop the motor. Assuming that the door is stopped from the master and that the interlocks of U had not been used, there might be a possibility that the reinserting of coils D and LOU might not be enough to insure that U would open. The interlocks insure that the circuit is actually open until U drops out.

The door is lowered in a similar manner by a circuit from line L1 through master fingers 106 and 107, which short circuits coils U and LOD and energizes coils D and LOU. In this direction, however, there is a maintaining circuit provided from line L1 through an interlock contact of D and the resistor A-B, so that even though the master is moved back to the off position, the door will continue to close until stopped by its limit switch.

The overload relays, when tripped, break the circuit from finger 107, and stop the motor. They are held tripped by shunt coils which are energized from finger 110 through resistor Y-Z to line L1 when the door is moving up, and through resistor Y-X to line L2 when the door is moving down. Since shunt and series coils must be accumulative for proper action of the overload relays, the series coils must also be reversed as previously described.

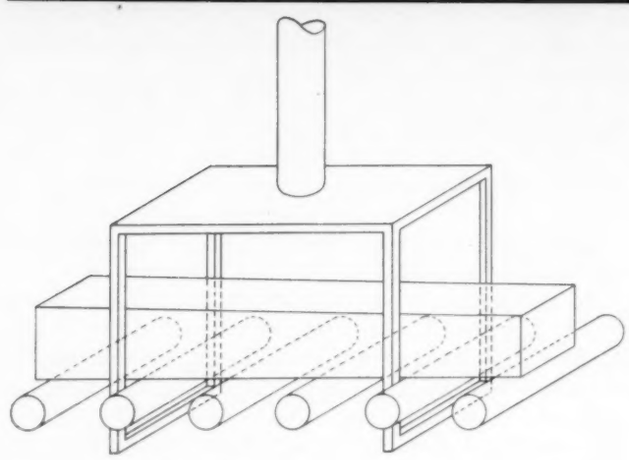


Figure 3 — Sketch of ingot-rotating machine.

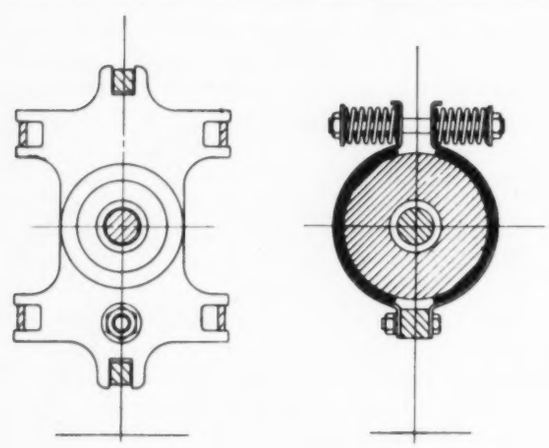
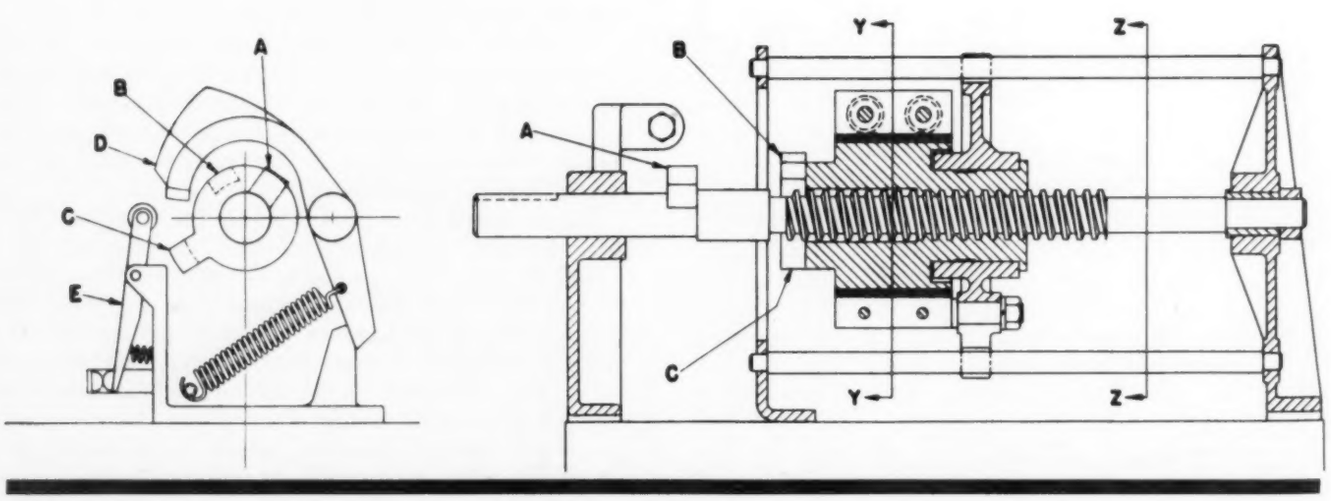


Figure 4 — Sketch of limit switch for ingot-rotating machine.



The relays C1 and C2 in the crane cab are double coil relays so designed that, with all four coils in series across the line, the relays will close, and so that with a very low current in the coils connected next to the lines, the relays will stay closed.

To raise a door from the crane cab, the operator moves the master in the cab in a direction to connect fingers 2 and 7. Relay C2 opens, but C1 remains closed and a circuit is provided from line L2 in the cab, through one coil of C1 to fingers 2 and 7, through the contact of C1 and the trolley to point 108. From there the circuit goes through off-position contacts of the ground master (which thus may take precedent at any time) through the overload contacts to the mid-point of coils U and D.

Similarly, to lower the door from the cab, the master is moved in the other direction, connecting fingers 5 and 7, dropping out relay C1, and bringing line L1 to the mid-point of coils U and D.

If an overload relay trips, the shunt coil will hold it tripped, as it will be energized from 110 through the trolley, and either through the contact and coil of C1 or those of C2. To reset the overload the operator must move the master to the off position and so open the circuit to the shunt holding coil.

It is probably self-evident that low voltage protection is obtained, because if power fails relays C1 and C2 drop out and cannot close again until the master is returned to the off position. It will also be evident that, if the crane is moved away from the furnace which it has been servicing, the trolley connection will be broken and relays C1 and C2 will drop out. The crane may then run along and make contact with any other trolleys, but connections will not be established to reclose C1 and C2 until the crane master is returned to the off position. In any case, however, a door once started down will continue to its fully closed position, because of the maintaining circuit through resistor A-B.

INGOT-ROTATING MACHINE

Figure 3 is a simplified sketch of an ingot-rotating machine which presented an unusual problem in limit switch design. The turning device is a sort of cradle, the bottom bars of which are normally down between the rolls of a roll table. The ingot is carried along on the table until it is within the cradle, and there stopped. The cradle is then lifted by a motor-driven screw thread arrangement until the ingot is lifted clear of the rolls. This requires eight turns of the screw. At this point the mechanism locks and the next half turn rotates the ingot 180 degrees. It is then set down on the roll table again. The cradle can only be lowered straight down, as it cannot be rotated with the ingot in it without reversing the ingot again, and neither can it be rotated after the ingot is again on the table, as the cradle is then down between the rolls. The exact mechanism of the turning device which accomplishes this is not known to the writer, but the machine uses a limit switch of the traveling cam type, and a similar operation of the limit switch is necessary. That is, in moving up, the switch must stop the motor after 8½ turns, but in moving down it must permit only 8 turns, and still must always return to the original starting position.

Figure 4 is a sketch of the limit switch which was designed to accomplish this result; and Figure 5 is a photograph of it. It was found to be more practical to work with full turns, and so the switch was designed to travel 17 turns up and 16 turns down, and then it was geared to the motor with 2 to 1 gearing.

Referring to Figure 4, the traveling nut or cam, shown in cross-section view Z-Z, is free on the limit switch shaft. It is guided and prevented from turning by guide rods running the length of the limit switch at top and bottom, and carried forward and backward by a member called the brake wheel. In doing so it operates switches used for slowdown in both directions, and for final stop in the down direction. It does not operate the final up-direction stop switch.

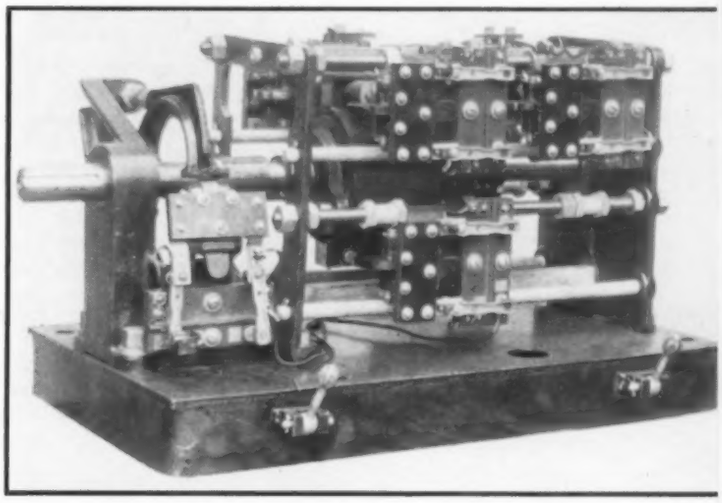


Figure 5 — Photograph of limit switch sketched in Figure 4.

The brake shoe, shown in cross-section view Y-Y, is bolted to the traveling cam, and so it also can travel forward and back, but cannot rotate.

The brake wheel, shown in view Y-Y, is threaded to the shaft and prevented from turning by the friction of the brake shoes. The brake wheel has two projecting lugs or dogs, B and C. The shaft also has a dog shown at A.

Assuming that the cradle is down, the limit switch cam will be at the extreme right, having stopped there after opening the down limit switch. When the cradle starts to move up, the cam will travel to the left, carrying with it the brake shoes and the brake wheel. After 16 turns of the shaft, dogs A and B come into engagement, and since this is a solid engagement providing a force much greater than the friction of the brake shoes, the brake wheel no longer moves forward but turns with the shaft. The cam therefore stops moving after 16 turns. As the brake wheel turns, dog C rotates in a counter-clockwise direction until it engages piece D. It forces piece D around against the pressure of the spring until the cammed surface of D engages the roller of switch E, which is the final up-direction stopping switch. In the position in which E opens to stop the motor, dog C is back again to its starting point, having rotated 360 degrees. The shaft of the limit switch has rotated 17 turns, but cam Z-Z has moved for only 16 of those turns.

When the cradle starts to move down, dogs A and B

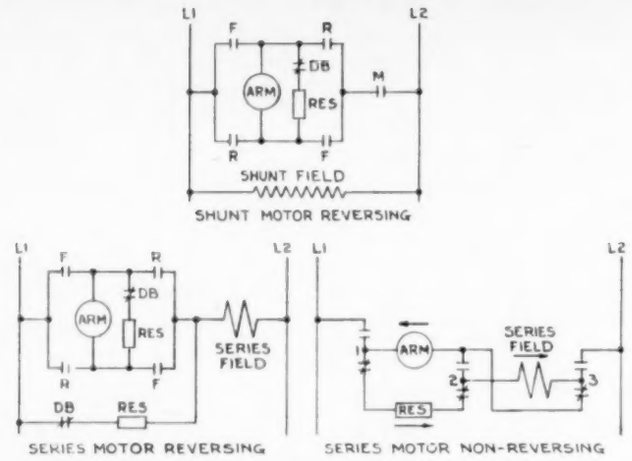


Figure 6 — Three commonly used circuits for dynamic braking.

no longer oppose each other and there is no force to oppose that of the brake shoes. The brake wheel therefore does not rotate but moves straight to the right, carrying the cam Z-Z with it, so that after 16 turns the switch is back in its original position.

As soon as dogs A and B slip away from each other, the spring on piece D returns it to its original position, resetting switch E.

Some ingot-rotating machines have been built to use two motors, one for lifting the cradle and the other for rotating it. With this arrangement a special limit switch of the type described is not necessary, since the two motions are independent of each other.

SAFE AND POSITIVE DYNAMIC BRAKING

The use of dynamic braking in connection with crane hoists is well known and understood, and the circuits are safe and relatively easy to set up. However, it is not a simple matter to set up a safe dynamic braking circuit for a machine requiring braking in both directions of travel, as, for example, a crane bridge or a transfer car. If the braking is to be effective whether or not the motor is plugged just before braking occurs, and whether or not a power failure occurs just before or during braking, the ordinary circuits and apparatus will not do the job.

Figure 6 shows some of the commonly used braking circuits. The circuit shown for the shunt motor will give braking in either direction of travel and regardless of whether the motor is plugged, but will not give braking when power fails because there will be no field circuit.

With a nonreversing series motor, effective braking may be secured with the circuit shown, in which the series field is reversed during the braking period so that the counter-voltage of the armature will send current through the field in the same direction that it was flowing when the motor was connected to the lines. This circuit will give braking if power fails.

The remaining circuit of Figure 6 shows a possible arrangement for use with a reversing series motor. Here the field is energized by a circuit set up during the braking period specifically for that purpose. The field will always be energized in the right direction, but no braking will be obtained if power fails. An obvious disadvantage, too, is that the field current during braking should equal the full-load current, and so the power loss will be high.

A study of these circuits indicates that for a satisfactory braking circuit it is necessary in some way to supply the series field current from the motor itself and not from the lines, and also to arrange that the current will always flow through the field in the right direction. Figure 7 shows schematically a device developed to accomplish these results, and Figure 8 shows the connections of the braking circuit. In these figures, 1DB, 2DB, 3DB, and 4DB are spring-closed magnetic contactors, mounted in a row and free to open at any time when energized. When the motor is running they are all open. A cam shaft extends across the four contactors, and this shaft is turned to either of two positions by electromagnets. One of the magnets is energized when the forward direction contactors are energized, and the cam shaft is turned so that contactors 1DB and 2DB are locked open by the cams. Then, when stopping or on voltage failure, only contactors 3DB and 4DB can close. The counter-voltage of the armature is in a direction to cause current to flow from A1 to A2, and inspection of the diagram will show that the braking current will flow through the series field in the right direction to give braking. When the motor is reversed the cam shaft is rotated into a position in which the cams lock out contactors 3DB and 4DB, so that when braking only 1DB and 2DB can close. The circuit is now correct for braking with counter-voltage from A2 to A1.

This arrangement has given good results in service,

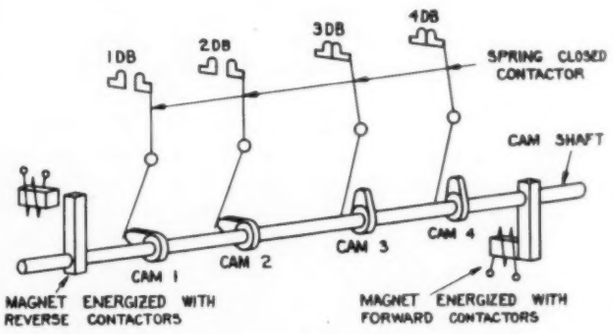


Figure 7 — Schematic sketch of device to improve dynamic braking circuit for series motor.

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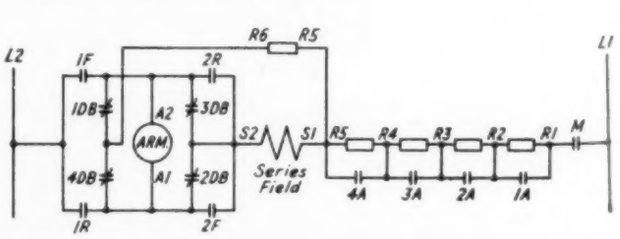
Figure 8 — Dynamic braking circuit for series motor, using device illustrated in Figure 7.



and with it braking is secured in both directions of travel, regardless of whether the motor is plugged, and also when power fails.

When a crane bridge is driven by two motors, as is often the case, the arrangement shown in Figures 9 and 10 will be found to meet all of the requirements of good braking. The circuit is shown in simple form in Figure 9. The armature of one motor is handled by the reversing contactors, but the field of the other motor is reversed. Four spring-closed magnetically released contactors are used for the braking circuit. These are standard contactors without any additional mechanism. All of them are open when the motor is running, and closed during braking. Assuming that the bridge is moving forward, current is flowing from L2 to L1 through armature number 1 in the direction of A2 to A1, and through armature number 2 in the direction of A12 to A11. Current flows through field number 1 from S2 to S1, and through field number 2 from S12 to S11. In stopping, all direction contactors open and all braking contactors close. The counter-voltage of armature 1 causes current to flow through the armature from A1 to A2, and through field 2 from S12 to S11. Similarly, the counter-voltage of armature 2 causes current to flow from A11 to A12, and through field 1 from S2 to S1. Both fields are therefore energized in the right direction, and each provides a braking field for the armature of the other motor. It is evident that this must be the case for either direction of travel, since current always flows in the same direction through armature 1 and field 2 which form one braking circuit, and the other armature and field are always reversed together. The controller of Figure 9 therefore gives a simple and positive braking method, either for normal stopping or in case of power failure.

Since the speed of a crane varies widely, and since the available counter-voltage and corresponding braking effort will vary with the speed, it is usually desirable to provide several steps of braking resistance if the braking is to be used for normal or service stopping. Figure 10 shows the usual arrangement in which three steps are used. The contactors which short circuit these steps are controlled either from the operating master or from a separate master or foot switch having three positions. For stopping from high speed, contactors 3DB, 4DB, 13DB, and 14DB are open and all braking resistance is in circuit. This resistance will allow approximately 125 per cent of normal current to flow. On the second point, contactors 3DB and 13DB are closed and the remaining resistance will allow approximately the same current if the motor is at normal speed. On the third point, contactors 4DB and 14DB close and the remaining resistor is designed to allow sufficient current for good braking from half speed. Series relays are connected in the braking circuits, controlling 4DB and 14DB so that if an attempt is made to close those contactors at too high a speed the relays will operate to prevent it. On power failure the circuit is the same as it is on the second, or normal speed, braking position. If power failed with the bridge at high speed, the braking would be more severe than might be satisfactory for service stopping, but not too severe for an emergency condition.

This type of control has been successfully applied to a number of cranes. A typical crane controller is shown in Figure 11. Some interesting tests were made at one

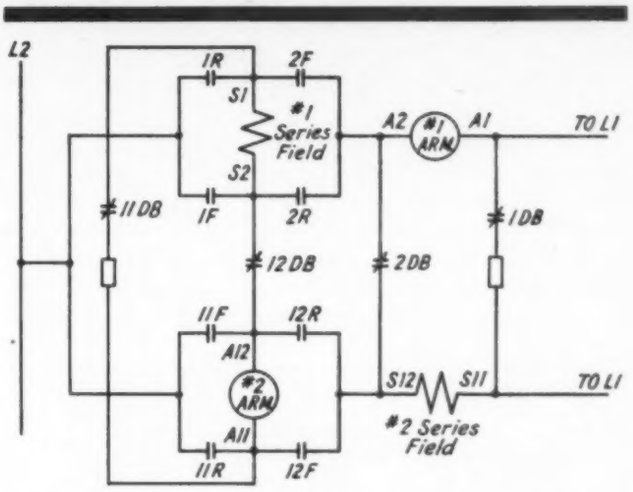
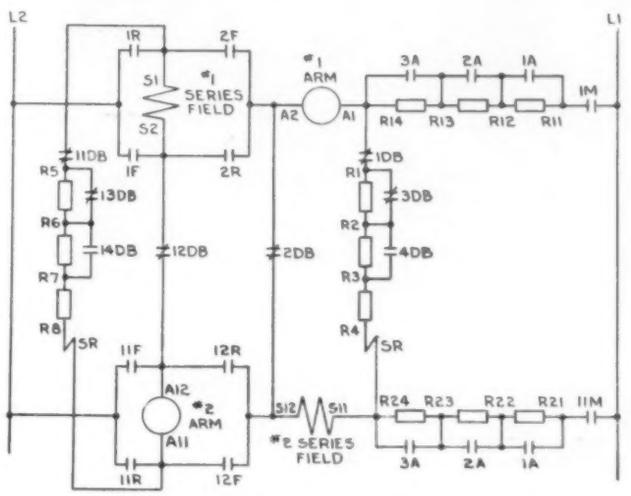


Figure 9 — Simplified circuit for dynamic braking of duplex drive.

Figure 10 — Usual arrangement of circuit for dynamic braking of duplex drive, using three steps of braking resistance.



installation where there were three cranes on one runway, each equipped with this control. It was therefore possible to operate the center crane in either direction, or to allow it to drift or to remain at rest for some time, and then in each case push it with one of the other cranes. It was found that braking always occurred, even after the crane had been allowed to stand at rest for some time. There was sufficient residual magnetism in fields to start a current flow, and the braking effect, once started, builds up rapidly. With this in mind, the scheme has been applied to large coal and ore bridges which are liable to be moved in their tracks by a strong wind, in which case dynamic braking will apply to limit the speed. Such an arrangement will not hold the bridge stationary, because no braking occurs unless the motors are turning, but it will limit the speed and reduce the chance of a wreck due to striking the bumpers at a high speed.

ELECTRONIC COUNTER

Figure 12 is an electronic counter which will operate

at very high speeds. The circuits are too involved to be explained in detail here but the general principle of operation can be explained without reference to the exact circuits.

There are ten electronic tubes grouped in a circle. Before any counting starts, the grid circuits of these tubes are connected to a voltage source which applies a negative voltage to the grids, with the exception that the grid of one tube is connected to a voltage which is higher (less negative) than that of the other nine tubes, but not positive enough to cause the tube to conduct.

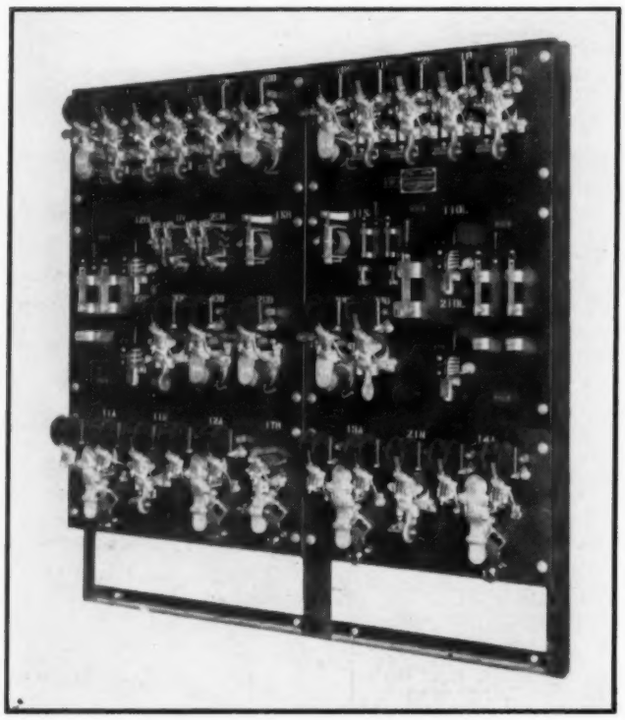
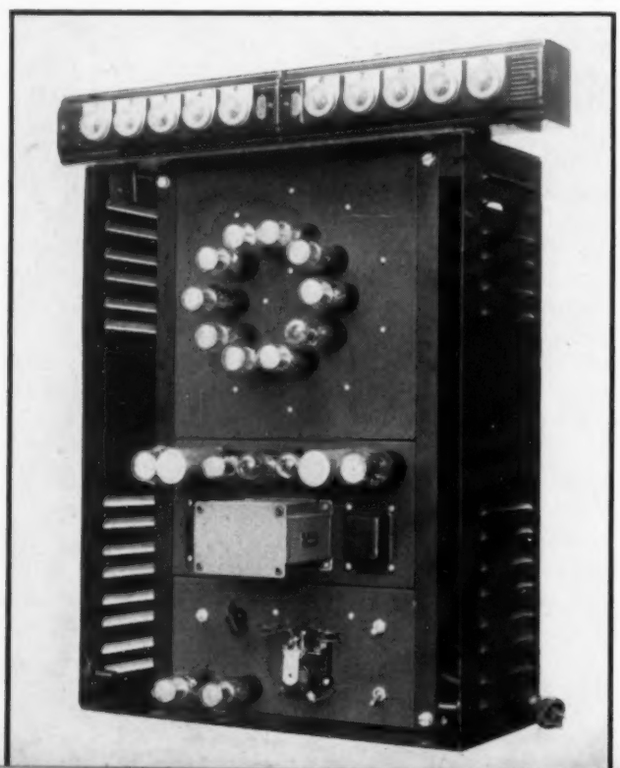


Figure 11 — Typical crane controller for duplex drive with dynamic braking.

Figure 12 — Electronic counter capable of operation at very high speeds.



This voltage might be called the preset voltage. When the first object to be counted operates a pick-up device, which may be a sensitive contact, a photo-electric tube, or some other such device, an increment of voltage is added to the grid circuits momentarily. This increment of voltage is enough to raise the grid voltage of the first tube enough to cause it to conduct. It is not enough to cause any of the other tubes to conduct, since their grid voltage is too low.

Across the top of the counter there is a row of neon glow tubes, each energized by one of the ten counting tubes. When the first tube conducts, the first glow tube lights, indicating that one object has passed the counting point and has been counted. Also, in conducting, the first counting tube sets up a circuit which raises the voltage on the grid of the second counting tube to the preset value.

When the second object operates the pick-up device, the voltage increment is again momentarily impressed on all of the tube grids, and this time the second counting tube is in a condition to become conducting. When it conducts, the second glow tube is lighted, indicating that two objects have been counted, and a circuit is set up to raise the grid voltage of the third counting tube to the preset value. There is also another circuit set up which stops the conduction of the first counting tube.

In the same way the rest of the counting tubes are preset and fired as counting proceeds, until the tenth tube fires. It causes the small relay at the bottom of the counter to close, and the relay in turn energizes a magnetic counter (not shown) which operates once. The neon lights thus indicate objects from one to ten, and the counter counts by tens. The maximum speed of operation of magnetic counters is about sixteen per second, so that with the arrangement described it is possible to count objects at a speed of 160 per second.

The speed may be increased by the addition of a second ring of counting tubes, used to count tens. One of these tubes would be fired after each complete cycle of the ten tubes in the first ring. The magnetic relay would be energized by the tenth tube of the second ring, and the magnetic counter would then be counting one object of each one hundred. The counting speed would then be 1600 per second.

The tubes do not have to be used in groups of ten, but rings may be compounded in any combination which will count the desired number of objects for each operation of the magnetic counter. For example, suppose it is desired to count twenty objects for each operation of the magnetic counter. This might be done with one ring of ten tubes and a second ring of two tubes, the total being twelve. It might also be done with a ring of five and another of four, or a total of nine, which would, of course, be more desirable.

The first step in designing a counter of this type is to determine the maximum speed of counting which is required, and determine a safe speed of operation for the magnetic counter. Dividing the first value by the second will give the number of objects to be counted by the tubes for each operation of the magnetic counter. This figure may then be divided into two or more factors which, multiplied together, will give the figure. Each factor then represents the number of tubes required in one of the ring circuits. The maximum theo-

retical speed of the device is that of the tube, which for a gas-filled tube is about 50,000 per second. This is probably considerably above the practical limit, which will generally be found to be in the pick-up device.

DISCUSSION

PRESENTED BY

P. E. THOMAS, Engineering Department, Carnegie-Illinois Steel Corporation, Gary, Indiana

P. B. HARWOOD, Manager of Engineering, Cutler-Hammer, Inc., Milwaukee, Wisconsin

H. R. MIDDLEBROOK, Assistant Division Superintendent Power and Fuel, Carnegie-Illinois Steel Corporation, Gary, Indiana

P. M. JOHNSON, Assistant to Superintendent, American Can Company, Maywood, Illinois

R. W. HOLMAN, Assistant to Electrical Superintendent, Gary Sheet and Tin Mill, Carnegie-Illinois Steel Corporation, Gary, Indiana

P. E. Thomas: I noticed that Figure 1 shows three cranes interlocked and requiring two split collector rails. You might have a condition where you have up to ten cranes on a runway. Would that require additional rails for each crane to be interlocked?

P. B. Harwood: An installation of three cranes was made in England a few years ago, and they later wanted to use four cranes. I tried to work it out with the same number of trolley rails and relays, but didn't have any luck with it. It could be done with additional trolleys, but I think that each additional crane would increase the complication greatly.

H. R. Middlebrook: Would it be possible to set up an interlocking system arranged so that when a crane got into trouble and went dead it could be pushed into a safe zone where it could not be bumped by another crane?

P. B. Harwood: Yes, that could be done. It would only be necessary to run the split trolley rails along the safe zone area, and either provide trolleys of insulating material for the rest of the runway or use a trolley shoe that could safely run off the trolley rail. Cranes in the operating zone would then be free to approach each other and would have no protection, but the dead crane would be safe from collision.

P. M. Johnson: I would like to mention that we have the same type counter at our factory as mentioned by Mr. Harwood. We have found this type counter very satisfactory and a great improvement over the mechanical type. At present it is counting sheets at the rate of 75 per minute. Although it has been in operation for almost a year, we have had little or no maintenance charges applied against it.

R. W. Holman: We have been looking for counters for tin plate sheets without moving parts for a long time, and I would like to ask Mr. Harwood if this can be made into a predetermining counter for a certain number of sheets, and at the end of a certain number of sheets cause a switching operation?

P. B. Harwood: Of course that can be done. You can use that relay I mentioned as used to operate a magnetic counter. You can just as well use it to operate a solenoid or trip switch of some kind.

R. W. Holman: Would it get into many tubes for 1120 sheets or 1680?

P. B. Harwood: The number of tubes would depend on the most economical series of factors that could be obtained from the number to be counted. There is an advantage in selecting a number which can be subdivided into several small numbers. Your number 1680 is such a number, as it factors into 2 x 2 x 2x 2 x 3 x 5 x 7. There is no gain in using two rings of two tubes as against one ring of four, as the total is still four. However, a ring of two and one of four will count eight using only six tubes, which is better than two rings of four. I believe that the minimum number will be obtained by using rings of 3, 4, 4, 5, and 7, making 23 tubes for counting. There would be half-a-dozen control circuit tubes in addition. This assumes all-electronic counting. If the process is slow enough to permit the use of a ratchet relay like those used in telephone circuits for the final step, the number of tubes can be reduced.

P. M. Johnson: We have used this type of counter to count a predetermined number of sheets, 1120 to be exact, making up a load of tinplate. When the 1120 sheets have been counted, the sheets feed into an upper auxiliary stack just above the full load of tinplate. The full load is then removed. Then, when three hundred sheets have been counted into the upper stack, the stack is automatically lowered and these sheets become the bottom part of the next load.

Mueller DISCUSSION

(*Continued from page 46*)

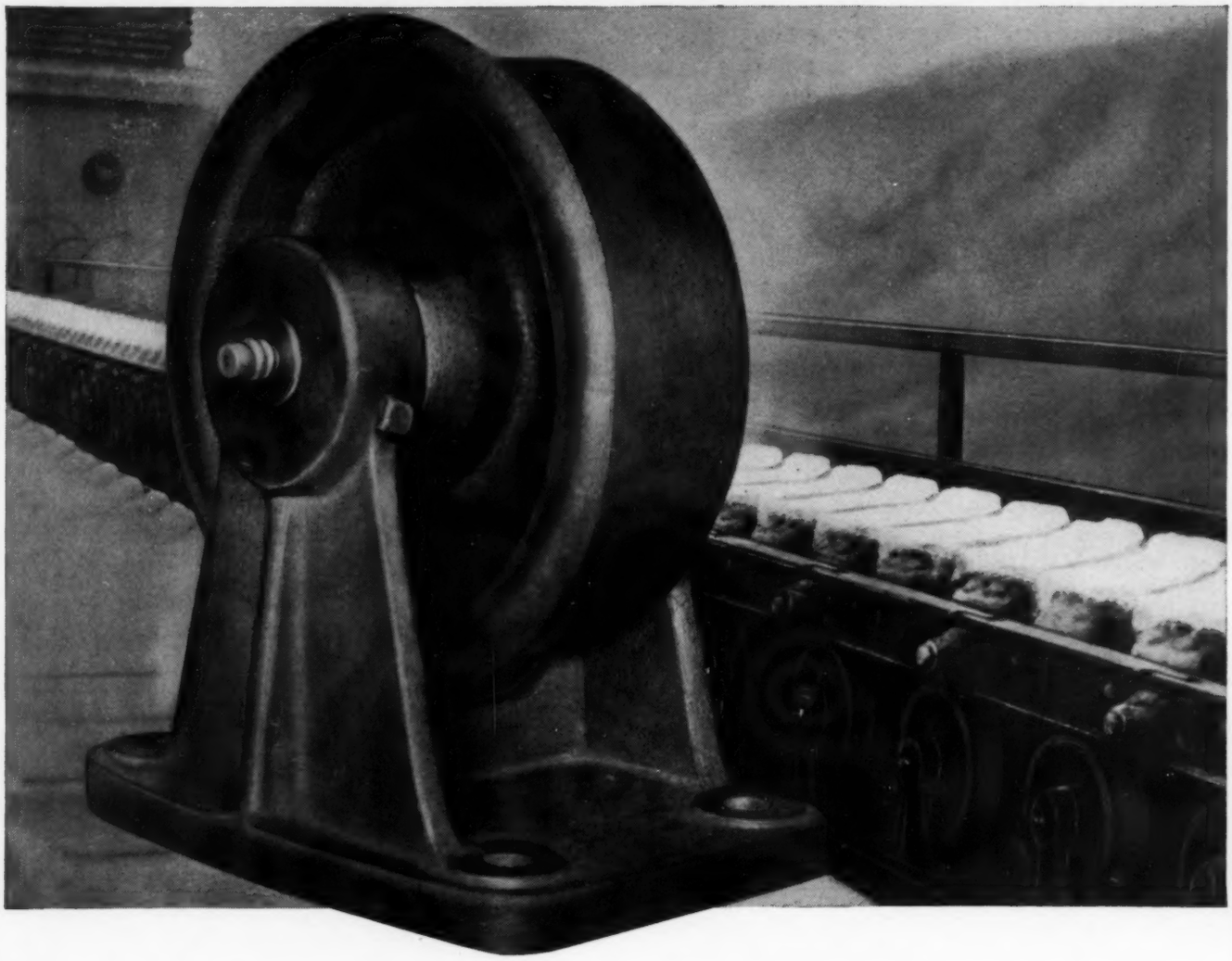
readily suspect from the configuration of the mill, there is considerable power variation throughout a stroke, but with the large rotating masses which tend to absorb and give up energy, these variations are not necessarily reflected at the motor.

I have listened to the synchronous motor driving the Hussey mill and there seems to be no tendency to pull out of step.

The rolling of combinations of dissimilar metals has been done. We have rolled a 90-10 bronze inside (90 copper, 10 zinc) with silver facings on it. I would say the silver facings represented 10 per cent of the total thickness, and that reduced perfectly all right. As far as I can see, any sandwich that can be rolled in an ordinary mill can be rolled on the Krause mill, because when you come right down to it, it is equivalent to a 4-high mill operating with tension. What you can do on equipment of that sort can be done equally well on this.

F. P. McCormack: The possibilities of hot rolling were mentioned. How do you propose to do it? Are you going to change the mill in any way? Wouldn't the bar cool down with the slow travel that you have now?

F. R. Krause: The proposed idea is to have the mill right ahead of the furnace, and discharge out of the furnace into a reducing atmosphere chamber to avoid scaling. This chamber is right in line with the mill, and the slab would be fed right through the chamber into the mill. Or it might be possible to heat the slab to just below the scaling temperature and hold that temperature with electrical or gas heating means.



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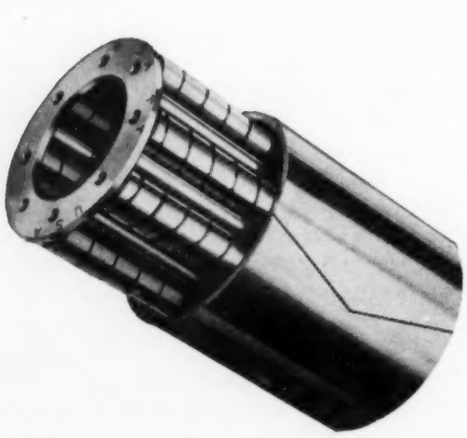

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Billet Preparations

FOR ROLLING MILLS

, . . . conditioning is vitally important in the production of high quality products . . . . the best method of conditioning is the prevention of defects in the preceding steps of the process . . . .

by F. F. CAMBEST. GENERAL SUPERINTENDENT
STEEL SUPPLY AND PREPARATION
JONES AND LAUGHLIN STEEL CORPORATION
PITTSBURGH, PENNSYLVANIA

▲ TO produce steel of high quality it is necessary that the semi-finished product, either billets, blooms, or slabs be thoroughly inspected and prepared for further rolling by having the visible defects, such as seams, cracks, scabs, and spongy surfaces, removed prior to the heating operation for further processing. There are several methods of accomplishing this result. The first to be put into practice was the hammer and cold-cutter, which was very clumsy, slow and costly. This was followed by the pneumatic hammer and chisel. While this was much more rapid and effective than the original, it was still costly and consumed a great number of man-hours per ton of prepared steel. This method, however, remained the best known for a number of years, and is still in use in some plants today, but its use is generally restricted to the harder grades of steel and those steels containing large quantities of alloys. Simplifying the problem further, the acetylene torch was introduced and, since its inception, has been developed to a marked degree of perfection. It is by this method that we are now conditioning all the steel used in the Pittsburgh Works of Jones and Laughlin Steel Corporation. This has been found satisfactory, although some steel has to be preheated and scarfed at a fairly high temperature. It is also necessary that this steel be carefully cooled, after preheating, or charged directly into the heating furnaces as soon as the scarfing has been completed. The above is concerned directly and wholly with the removal of surface defects.

In order to determine the suitability of steel for the special purpose for which it has been made, it is often necessary to determine internal soundness. This is done by etch-testing, a process consisting of sawing the ends from billets taken from certain specified locations within the ingot and the heat. This saw-cut section is placed in a heated acid bath and permitted to remain there until the surface has been thoroughly cleansed and the impurities eaten away. One schooled in judging can tell a great many things by looking at this test. He can, for instance, see whether there is a decided pipe in the center, whether the steel is rimmed or killed, whether there are indications of unsealed blowholes near the surface which will develop into seams when the surface has been machined away, and whether there are certain inclusions within the steel itself which will make it unsuitable for the finished product. It is therefore important that the one judging the application of this steel be well grounded in interpreting these symptoms.

Another method to determine internal cleanliness or freedom from pipe is the "nick-and-break" or fracture test method. This is done by burning in on all four sides of the billet or bloom about four inches from the end, leaving a small portion intact which is then broken off.

Presented before A. I. S. E. ANNUAL CONVENTION, Pittsburgh, Pa., Sept. 25-27, 1944

This small piece and the fracture end of the billet proper is then examined visually for pipe.

The surface preparation is guided by the size, shape and ultimate use of the finished product. The reduction of the billet to its finished size is of prime importance and is a barometer as to the depth of defect removal. By this it is meant that the surface may be removed to a greater depth where bar mills will subsequently make a large reduction in bringing the billet to finished bar size. Too great a depth in billet surface removal where bar mill reductions are small often results in mechanical defects such as laps or holes where the metal is insufficient to fill out the bar. It is therefore of prime importance to have on hand a table of reductions of the various bar mills for which the billets are being prepared. In the processing of billets for the more critical types of products it is absolutely necessary that all the scale from the blooming mill heating be removed. This scale may be removed by different methods, but the most prominent and most widely used is pickling in a sulphuric acid and water solution. The removal of this scale reveals defects that cannot be otherwise seen, the most prominent of which are seams.

Seams are the most troublesome defects in the steel industry, and many devices are now being used in various manufacturing plants to determine the presence of seams, as well as their depth, prior to the manufacture of forgings and parts. The type of seam we are referring to are those that cannot be seen on visual inspection of the finished bars, but are found by magnetic testing of a prepared sample. On the more critical forgings and propellor shaft steels now being used on the various landing craft boats, a second pickling is often given the billets to check the initial preparation and to show up the minute defects that may be missed the first time. New machinery in use at some manufacturers' plants today is designed primarily to prevent losses in metal and to save time in manufacture, and are such that extra preparation is necessary to meet exacting demands.

Scarfing has proven to be an economical process and has opened a serious bottleneck through its saving in manpower.

Double converting, saddening and rerolling are resorted to in cases of this kind.

In the preparation of steel, especially in the high sulphur bessemer grade, it is often found that the surface is practically covered with innumerable small slivers. Of great help in conditioning this steel is the hot flame scarfer, a mechanism set up in the line of travel of the hot bloom somewhere between the bloom and billet mills. This machine is fitted with a number of acetylene torches which play on all sides of the bloom and remove a certain definite amount of steel varying in depth according to the oxygen pressure and the speed with which the steel travels. This not only removes surface slivers, but also to some extent any spongy surface of slight depth.

In the scarfing process the design of the tip of the torch is of great importance. Many tips were discarded before the proper relation between the gas and the oxygen ports were properly fixed, and from time to time this relation is still changing.

The training of the personnel in the use of the scarfing torch has been a major problem. Little skill was required to use the pneumatic chisel, practically all that was needed was a strong back. The torch, however, requires coordination between the eye, the hands and the feet of the operator. Unless the man is extremely careful, a jiggling of the torch will result in uneven removal of steel, leaving the billet full of grooves and holes which, in the rolling operation, will result in laps or seams. It has been found that an average workman under the direction of a skilled instructor may learn to scarf the commoner grades in about three months. However, it will take him approximately a year before he can be trusted with the more sensitive grades of steel for orders which require a specially good surface.

At the present time, machines are being developed for the removal of steel defects, and have been particularly successful on the larger size blooms. These machines are finding a large field in the preparation of steel for seamless tubing and heavy forgings. However, for the ordinary run of bar mill products, we believe the scarfing method to be the most economical up to the present time.

In comparing the economy of the various methods of conditioning steel we can make direct reference to the forces necessary to pneumatic chip and torch scarf as follows: In the year 1941, we had in our employ approximately 650 pneumatic chippers. In the year 1944, we have no pneumatic chippers, but are conditioning a considerably higher tonnage of steel with 100 torches. Although it requires considerably more auxiliary help to serve the scarfers than the chippers, there is still a greater saving in man-hours, which is highly desirable during this period of labor shortage.

In laying out new facilities for steel conditioning, the beds should be located as close to the blooming mill as possible, so that full advantage can be taken of the residual heat when scarfing sensitive grades. On some of the alloys, it has been found desirable to perform this work while steel is at a temperature as high as 500 F. It is also necessary to cool this steel very slowly after scarfing in order to prevent internal as well as external cracking.

We realize that this broad subject has been covered here very sketchily. The conditioning of billets, blooms

and slabs is vitally important in the production of high class steel products and should be given considerable attention at all times. We do believe, however, that the best method of conditioning is the prevention of defects in the ingot as delivered to the soaking pits, and in the bloom or billet as delivered to the conditioning beds. We would suggest that this matter be given even greater attention than is given the elimination of defects resulting from malpractices in these departments.

DISCUSSION

PRESENTED BY

R. O. HUNT, Superintendent of Conditioning, Carnegie-Illinois Steel Corporation, Duquesne, Pennsylvania

F. F. CAMBEST, General Foreman, Steel Supply and Preparation, Jones and Laughlin Steel Corporation, Pittsburgh, Pennsylvania

LOUIS MOSES, Superintendent, Rail Mill and Roll Department, Bethlehem Steel Company, Sparrows Point, Maryland

JOHN F. BLACK, Assistant Works Manager, Atlas Steels Limited, Welland, Ontario, Canada

R. O. Hunt: I would like to ask whether materia[l] going out of the plant to the trade is scarfed?

F. F. Cambest: My paper dealt entirely with the conditioning of billets and blooms prior to rolling into finished product. Finished product is usually hammer chipped or ground. We have scarfed some finished product in cases where we knew its application.

Louis Moses: I would like to ask Mr. Cambest about the organization of the crew of scarfers. Is responsibility of where and how much to scarf centered in an inspector or supervisor who directs the operation?

F. F. Cambest: The responsibility of where and how much to scarf lies with the inspector, known as a crew leader in our organization, who is under the jurisdiction of an inspector foreman.

John F. Black: Is it economical to take everything through the scarfing machine or are some grades better hand scarfed? I understood Mr. Cambest to say that there was no conditioning done after hot scarfing, i.e. hand chipping, mechanical chipping, billeteer or hand scarfing. Is this true?

Another thing: To what extent is alloy steel handled? What is their experience in hot scarfing these grades?

F. F. Cambest: In our plant, all grades go through the hot flame scarfer. Such blooms are subsequently hand scarfed.

As to the type of alloys we scarf, we have scarfed thousands of tons of WD 4140 grade which contains 80/110 chromium; otherwise, the elements are normal, with 38/43 carbon. WD 4150 grade which runs a little higher in carbon (46/53), with 80/110 chromium, is scarfed, as is WD 8750 grade which runs 48/53 carbon with triple alloy. However, the triple alloys are only about ½ of one per cent. Bullet core, 65/75 carbon, 75/100 manganese, with normal elements otherwise, excepting molybdenum of 85/105, is also scarfed. That has been the extent of our scarfing on alloy steels.

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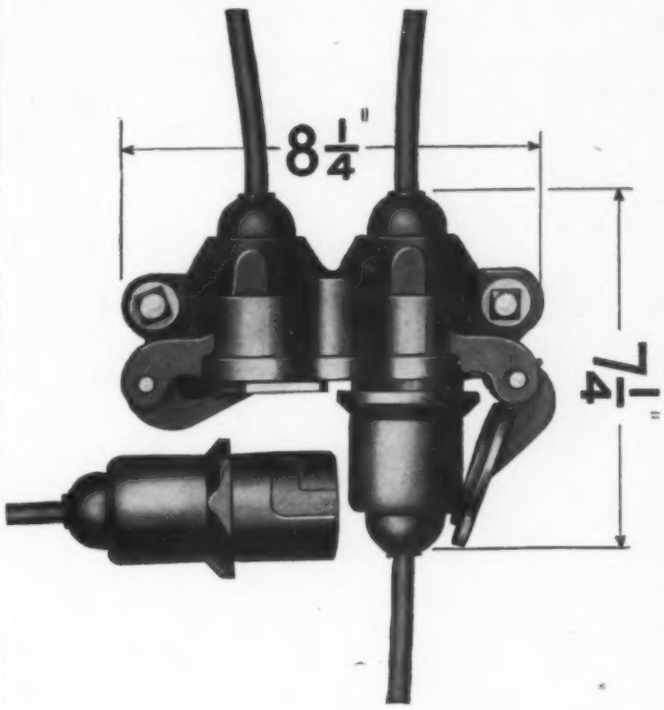

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SOME DEVELOPMENTS IN

Modern Transformer Design

. . . . improvements in the design and construction of transformers have reduced costs and increased reliability . . . . the dry type, air cooled designs offer many advantages and have proven themselves in operation . . . .

by W. W. SATTERLEE, DIVISION ENGINEER
WESTINGHOUSE ELECTRIC CORPORATION
SHARON, PENNSYLVANIA

▲ THE large industrial expansion of the past few years has of necessity been made in many instances without too careful regard to the kind and rating of the equipment really needed to do the job most satisfactorily and economically. In many cases it will be necessary to rearrange existing equipment or to purchase new equipment for the manufacture of postwar products. In doing this, a contribution which the electrical equipment manufacturer can make lies in the development of apparatus which will effect lower investment, lower cost of installation, lower operating costs, and less maintenance.

The performance of the electrical power industry in continually decreasing the cost of electric energy has from the beginning been an inspiration to us all. The development of transformers has perhaps not been so spectacular; however, it has paralleled that of the industry as a whole and has contributed in a large measure to the economics which have made electric energy the servant of everyone.

Undoubtedly, new developments will play a major part in the generation and distribution of electric energy. Since that subject is very broad, I will consider it only from the standpoint of a single, but particularly important, piece of electrical apparatus — the transformer — by reviewing briefly some of the more modern transformer developments.

Presented before A. I. S. E. Philadelphia District Section Meeting, November 4, 1944.

SPARE TRANSFORMER CAPACITY

For many years, main supply transformers in this country were usually made single phase. One important reason for this is the possibility of reconnecting a bank of single-phase transformers in open delta in case of failure of one of the units. When this was not practicable, it has been common practice to supply a spare transformer. The spare transformer serves no useful purpose; it is simply expensive insurance against an extended interruption of service in case of failure of one of the supply transformers.

A few years ago there was a trend toward the use of three-phase transformers. Stimulated by the need of using all critical materials most advantageously during the war, the use of three-phase transformers has grown until today two-thirds of the new power transformers purchased are three-phase compared with 10 to 15 per cent ten years ago. The use of three-phase transformers is justified because of certain distinct advantages. For instance, new materials and insulating techniques have made possible a great reduction in the size of these transformers. (Figure 1). Thus, han-

dling and installation are made easier. First cost is lower; space requirements, foundations and installation costs are less than for three single-phase transformers. Better materials, improved manufacturing and inspection, and better testing facilities and techniques have eliminated to a large extent the previous causes of transformer failure, so that three-phase transformers are accepted for general application and their full advantages realized.

INCREASED TRANSFORMER CAPACITY

Liquid-filled transformers are most frequently self-cooled, that is, by the natural circulation of the liquid through their windings. The heat is thus carried by the liquid to the tank and radiators and thence dissipated to the surrounding air. If air is blown across the radiators by means of fans, the heat efficiency is raised and the load that the transformer will carry for a given temperature rise is increased. Depending upon the size of the transformer, the increase in load is normally from one-fourth to one-third.

Another very effective method of obtaining greater capacity by increased cooling is to force the liquid through the windings of the transformer. Forcing the liquid through the windings of the transformer greatly reduces the temperature gradient between the copper and the liquid. A great advantage in this method of cooling is that it reduces the maximum hot spot temperature of the transformer for a given load and makes possible more effective use of the transformer radiating surfaces. Because of the smaller size of these transformers, it is often possible to ship them completely assembled, thus eliminating or greatly reducing field erection time and expense. Where the application is suitable, forced liquid cooling offers a means of making substantial savings in cost.

LOADING BY COPPER TEMPERATURE

It is good economics to load electrical equipment to its safe limit. The maximum output of a transformer at any time is limited by the temperature of the copper and the insulation surrounding it. The life of the insulation depends both upon the temperature to which it is exposed and the length of the time of exposure. Transformer capacity available in any particular unit at any time, and often unused depending upon operating conditions, has several sources. One is heat storage capacity and other thermal characteristics; another is dependent upon the conditions of loading up until the time that extra load is desired; still another is the ambient temperature. Obviously, operators cannot anticipate these factors and take them into consideration in loading transformers. Consequently, larger transformers than are really necessary are frequently installed to handle a given load.

Loading transformers by copper temperature makes it possible to use most all of their available capacity. Thus, a saving in capital investment may be made. Such loading can be accurately controlled by thermal relays calibrated to follow the temperature of the transformer windings, that is, loading by copper temperature is obtained. A simple reliable relay of the bimetallic type has been developed for this purpose. Mounted inside the transformer case, it obtains its temperature response from the hottest oil and from a current proportional to the winding current circulated through the bimetal elements. (Figure 2.) This relay automatically takes into account all of the factors which influence transformer temperatures and accurately integrates them. It permits the transformer to carry any safe load and automatically signals in case a dangerous overload condition is approached.

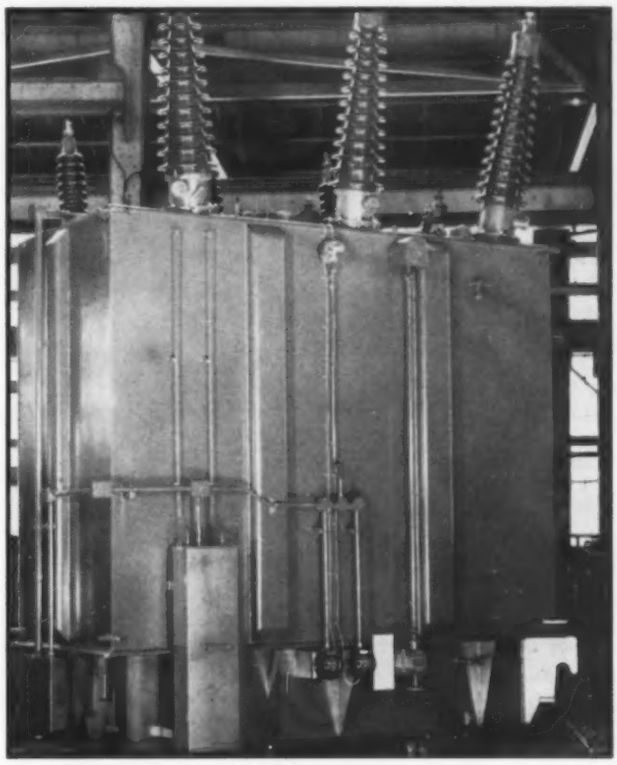
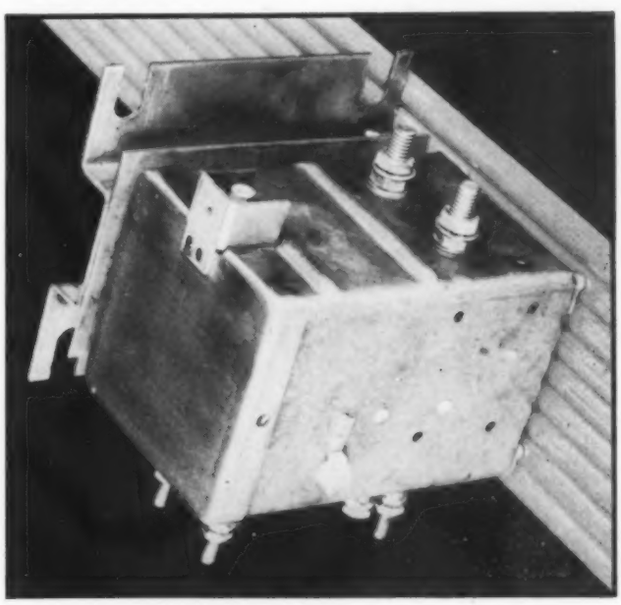


Figure 1 — Three-phase power transformer rated at 15,000 kva, 161,000 volts.

▲

Figure 2 — Temperature relay of bimetallic type, which is mounted inside of the transformer case for thermal protection.



IMPROVEMENTS IN SILICON STEEL

Silicon steel which is used as the core material for transformers has been improved in quality since its introduction. As the quality was improved, transformer cores were worked at higher induction to obtain a given loss and the size and the cost of the transformers were reduced. Finally a point was reached where working densities approached the knee of the saturation curve and exciting currents became excessive. Research work was then directed toward the development of a new kind of steel in which permeability and core loss would be simultaneously improved so that the steel could be used at higher densities without increasing the exciting current of the transformers.

The result of this development is a much improved new magnetic material which can carry as much as one-third more magnetic flux in the finished transformer core. Thus, transformers are built with high efficiency levels and with weights and dimensions markedly reduced.

SHELL FORM-FITTING TANK

An interesting and important recent development in power transformers is the shell form-fitting tank. This tank, as its name implies, is one which closely fits the contour of the transformer. It is so constructed that it lends mechanical support and extra bracing to the core and coil assembly.

The base or lower-section of the tank is designed to support the core of the transformer and it incorporates the function of the bottom end-frame and coil bracing into that of the tank itself. The upper section of the tank is welded to the base with an oil-tight joint, at a level of only three or four feet from the bottom of the transformer.

The core and coils are built into the base of the tank. Thus, the shell form-fitting type of construction has the advantage that if it is necessary to untank the transformer, the top section of the tank, which is comparatively light, can be lifted off with a small crane or hoist. (Figure 3.) The height required to untank the transformer is materially reduced since it is only necessary to clear the superstructure of the core and coils with the upper section of the tank.

Radiator valves, drain valves and other fittings located at the bottom of the tank are protected during handling and shipment by an overhanging section of the base. This tank is braced to withstand not only the internal pressures commonly experienced in normal operation, but also a full vacuum. This is an important feature of construction since it readily permits reconditioning a transformer in the field to restore it to its original factory condition so far as dryness and dielectric strength are concerned.

The form-fitting tank means a transformer of approximately 15 per cent less total weight and a saving of about 25 per cent in floor space. Thus, the size of the foundation required and the handling necessary to install the transformer is materially reduced.

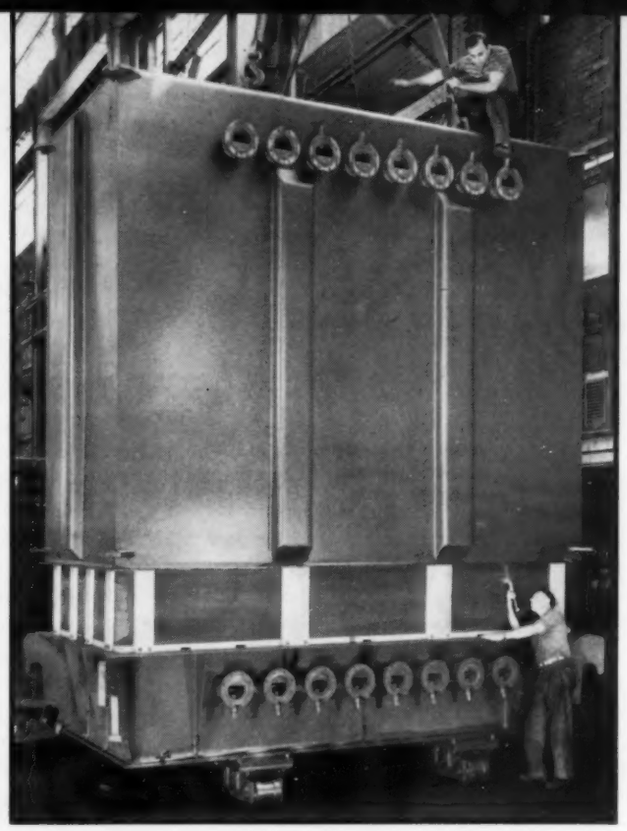


Figure 3 — Showing the upper section of a shell form-fitting tank being lowered into position.

DRY TYPE AIR-COOLED TRANSFORMERS

No liquid-filled transformer is explosion-proof in the true sense of the word, although the use of inert gas, relief devices and protective relaying does reduce the probability of explosion. Realizing this, it seemed that dry type air-cooled transformers constructed with class B insulating materials would be free of explosion and essentially fire-proof. Dry type transformers have thus been developed in the larger ratings and higher voltages needed to serve modern indoor distribution systems. These transformers have many interesting and desirable installation and operating characteristics.

There is available today a line of dry type transformers ranging in size from 150 to 4000 kva, and in voltages up to and including 15,000. These transformers are cooled simply by the natural circulation of air through their core and coil structures. By the application of forced air-cooling, the capacity of these transformers is increased materially.

These dry type transformers are explosion-proof and essentially fire-proof because their major insulation is principally air and porcelain. In fact, their insulation structures are made up largely of inorganic substances such as porcelain, glass, asbestos and mica, or combinations of these and other substances, bonded together with a heat-resisting varnish.

Although the continuous temperature limit specified for class B insulation was established some time ago at 130 C, it is obvious from the definition that there might be different combinations of organic and inorganic substances that would withstand temperatures varying over a considerable range. A. I. E. E. standards recognize this by the statement: "Materially higher 'hottest-

spot' temperatures may be satisfactory for particular forms of class B insulation . . . " Such a combination of materials is used in the insulation structures of these transformers.

DESIGN AND CONSTRUCTION

Let us consider some of these insulating materials and how they are used in these transformers so that they will give satisfactory service over long periods of time even though under rated load their hottest-spot copper temperature may be in excess of 130 C.

Winding conductors are insulated with glass or asbestos. Air ducts are formed between sections of the high and low voltage windings by spacers of glass, porcelain, mica or asbestos. High voltage windings are

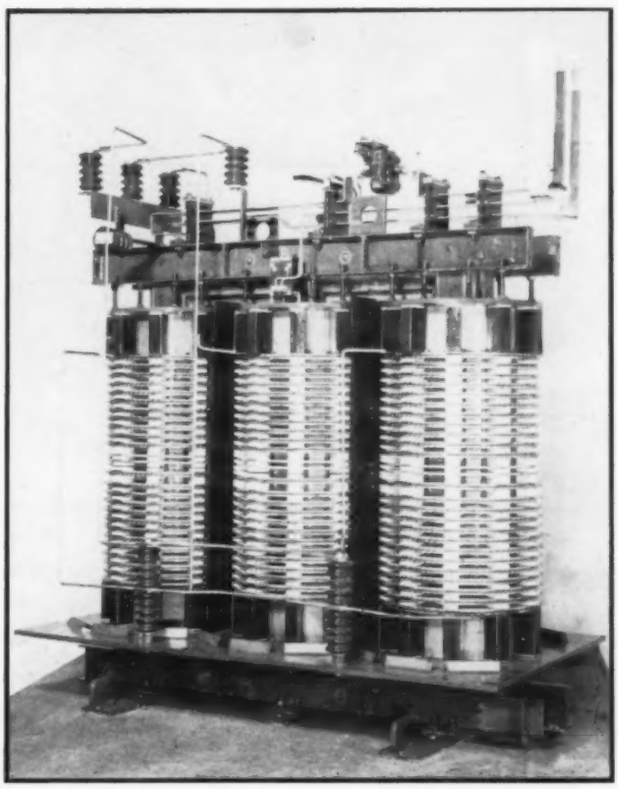


Figure 4 — Core and coil assembly of dry type, three-phase transformer rated at 500 kva, 13,000 volts.

supported on porcelain. Porcelain is used to center the high and low voltage winding assembly on the core. A clear cylindrical duct of air separates the low voltage winding from the high voltage winding. Dirt which falls into this high potential area simply drops through to the bottom of the transformer case. Horizontal creepage surfaces in high potential areas are eliminated. High voltage and low voltage leads are supported on or terminated in porcelain insulators (Figure 4).

The windings and the core and coil assemblies are treated with a heat-resisting varnish and baked at high temperature. Baking eliminates the residual volatile matter and the treatment imparts a smooth, tough, glossy finish to the complete structure which makes it highly resistent to dirt, heat and moisture.

It is of interest to know what the operating temperatures of the windings and the insulation structures may be and how these transformers are assembled to withstand copper temperatures in excess of 130 C.

Insulation nearest the winding copper is necessarily subjected to higher temperatures than insulation physically removed from the copper. For instance, the conductor insulation is for all practical purposes subjected to the same temperature as the copper. However, insulating barriers which are not in thermal contact with the copper operate at appreciably lower temperatures than the windings.

A comparison of actual winding and barrier temperatures obtained on transformers tested under rated load and on the basis of an ambient temperature of 40 C shows that the maximum copper temperature will range from approximately 140 C to 155 C. Under the same operating conditions barrier temperatures range from 25 C to 40 C below the maximum winding temperatures. Life tests on the barrier insulation used in these transformers show that it will withstand a continuous temperature of 130 C without detrimentally affecting its electrical and mechanical properties. None of the insulation which may reach a temperature in excess of 130 C is subjected to line-to-line or line-to-ground voltage stresses. The voltage where temperatures above 130 C may occur is limited to winding turn-to-turn stresses which are less than 100 volts. Thus failure from overheated insulation and electrical breakdown is greatly reduced.

Overload and fault tests representative of abnormal operating conditions have been made on dry type transformers of this kind. For instance, a winding assembly withstood a sustained short circuit of 15 times normal current for two minutes without reaching a temperature high enough to ignite the varnish. The copper temperature was in excess of 400 C. It should be noted the winding was subjected to this short circuit for two minutes, which is fully 25 times longer than the three to five seconds normally required for overcurrent protective relays or breakers to clear a circuit under the same conditions.

Another test consisted of a power arc of over 5000 amperes sustained for a short time in a transformer which had first been preheated to 100 C, an approximate normal operating temperature, without ignition of the varnish. This is representative of an insulation breakdown in the windings of a transformer connected to the lines of a power system.

Still another test consisted of applying a sustained overload of 120 per cent of rated load to transformers of this type for 27 hours followed by 167 per cent of rated load for 20 hours. The windings reached a constant temperature of approximately 270 C. Considerable smoke was given off but the varnish did not ignite. Two hundred per cent of rated load was applied immediately and the varnish did not take fire until after three hours, and with the windings at a temperature of approximately 400 C.

These tests demonstrate that this type of air-cooled transformer will carry continuously in excess of 160 per cent of rated load before ignition of the varnish might occur. Actual experience under emergency operating conditions has shown that loads heavier than this may be carried for reasonable periods of time without the transformer windings reaching a temperature which would cause the insulation to smoke.

Sheet-steel cases with louvered or screened openings are used to enclose these transformers (Figure 5). Thus, ample protection against accidental contact with live parts is afforded. A recent amendment to the National Electric Code approves the installation of dry type transformers constructed with class B insulation without the use of fire-resistive vaults.

FACTORY AND SERVICE TESTS

A 500 kva, 13,800 volt, three-phase, dry type transformer was given an outdoor rain test for 16 days with a water spray applied continuously around the case. The transformer carried no load but was excited at 13,800 volts.

Following this test, the transformer was subjected to the standard dielectric test of 31,000 volts for 60 seconds with no signs of distress whatever. While these dry type transformers are intended only for indoor application where very little moisture is likely to be present, these results are reassuring when condensation or the effects of high humidity during installation and operation are considered.

A 150 kva, 2400 volt, three-phase, dry type transformer, enclosed by an open screened case, has been under test continuously for over two years supplying power for the operation of motors and other equipment. The load cycle begins each week at 8:00 A.M. on Monday. The test is conducted in a relative humidity of about 95 per cent and at a room temperature varying from 30 C to 50 C. At 4:00 P.M. each day through Monday to Saturday, and over the week-end, the load is removed but the transformer is kept energized and the high humidity is maintained. Under these extreme conditions this transformer has given continuous service and there are no indications of a deterioration of the varnish or of the insulation.

Another dry type transformer, enclosed by a sheet steel case with louvers, has been subjected to temperature and moisture tests for more than 2000 hours. The load was adjusted so that the maximum continuous winding temperature was 175 C. The load is maintained 16 of each 24 hours during five days of each week. At the end of each 16-hour period, water spray is directed against the transformer case for five minutes. The transformer is then allowed to stand 8 hours of each day without power applied. At the end of each weekly cycle, immediately following the last 16-hour load period, a dielectric test of 4000 volts is made from the high voltage and low voltage windings and to ground, after which the water spray is applied for 5 minutes. The transformer then remains deenergized for 56 hours when power is again applied and the weekly test cycle is repeated.

A careful examination of the transformer after the 2000-hour test period disclosed some deterioration of the varnish but no insulation failures have occurred nor were there any indications of a decrease in the dielectric strength of the insulation.

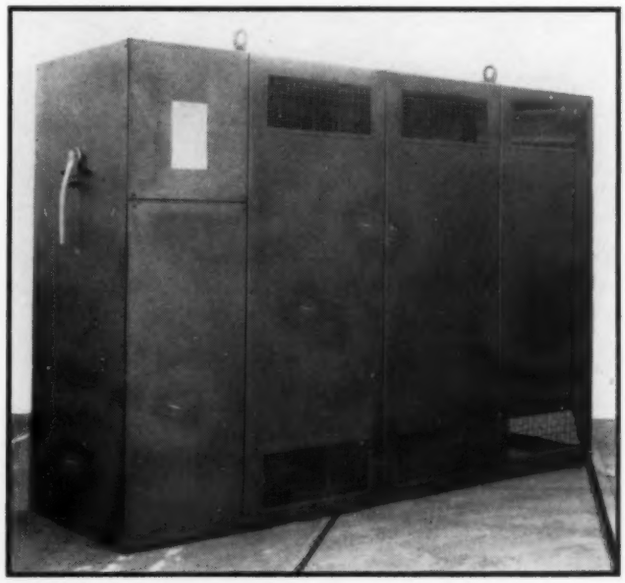
OPERATING EXPERIENCE

Many transformers of the dry type have been in continuous operation for more than 7 years. Today there are over 2000 transformers in service totaling approximately 1,000,000 kva. Never has a breakdown of the winding insulation occurred in any of these transformers which could be directly attributed to an excessive winding temperature, an accumulation of dirt, the effects of condensation or operation in a humid or any other atmosphere.

Figure 5 — Single-phase dry type transformer, 333 kva, 11,000 volts.

▲

Figure 6 — Three-phase unitized dry type network transformer rated at 750 kva, 13,000 volts.



Certainly some troubles have been experienced but most of them have been of a minor nature. With over 2000 transformers in service, four failures which may be considered of a major nature have occurred. Suppose we review the cause of these failures, what happened to the windings of the transformers and what was done to place the transformers back into service.

A 600 kva, three-phase, 6900 volt, dry type transformer flashed over as a result of a severe lightning surge. The voltage impressed on its high voltage winding was estimated to be in excess of 100 kv. Connected directly to the secondary of a 45,000 kva bank of power transformers, this dry type transformer had no lightning protection of any kind or no overcurrent protection between it and the power transformer bank feeding it. The high voltage winding was severely damaged; the line leads and a considerable portion of the winding were fused because the system breaker on the 150,000 volt line feeding the power transformer permitted arcing for a considerable period of time. It is of particular interest to know that neither an explosion nor a fire occurred. It was necessary to replace the windings.

A 1000 kva, 13,800 volt, dry type transformer was temporarily put out of service because of a lightning surge. However, in this case, flashover occurred across two plain rectangular porcelain insulators which were used to support high voltage leads. As a secondary result, a small arc occurred at one point between the two outer turns of the top high voltage coil section of one phase. The turn insulation was only slightly damaged. Permanent repair of the winding was made and the transformer was put back into service within two hours after the failure. Later, high voltage lead supports were replaced with round corrugated insulators in line with present day practice.

Two other dry type transformers failed after short periods of service. One failure was caused by a short circuit between two adjacent turns in the high voltage winding, apparently the result of a poor joint in the copper which punctured the insulation. Repair was effected easily and quickly. The other transformer outage was caused by the flashover of a porcelain lead support which may have been due to an excessive accumulation of dirt. The only repair necessary was to replace the lead support.

There have been instances where a number of these dry type transformers operated under emergency conditions at overloads ranging from 150 to 200 per cent of rated load for continuous periods of time in excess of 24 hours. The windings must have been subjected to temperatures appreciably in excess of 160 C.

For instance, a bank of 150 kva, 4000 volt transformers carried in excess of 150 per cent of rated load for a period of nearly three days. This overload occurred over four years ago. Careful inspection did not indicate any noticeable deterioration of the insulation. These transformers have continued to give uninterrupted service.

Two years ago, another bank of dry type transformers carried approximately double load for more than 24 hours. These transformers have continued to operate without any ill effects of this heavy overload.

A 600 kva, 13,800 volt transformer, after having been in service over one year, was operated at 200 per cent of rated load for a period of 30 hours. No failure occurred and the transformer has continued in service with no signs whatever of trouble.

If an insulation breakdown occurs in the winding of these transformers, its presence is immediately detectable by the smoke rising from the overheated part. Arcing in a liquid-filled transformer may continue undetected for hours.

When these dry type transformers are installed with overcurrent protection as required by the code, their windings cannot attain a high enough temperature to cause ignition of the varnish. Even if the overcurrent protection should fail to function or if it should not be present and ignition of the varnish occurs, a fire is likely to spread but a short distance beyond the case. Combustible materials should not be placed that close to any transformer.

APPLICATION

Many of these dry type transformers are in service installed in power stations, office and factory buildings, mines, chemical plants, steel mills, and other indoor locations. Most of them are installed without the use of expensive vaults or fire-walls.

The load carrying ability of these dry type transformers is as good or better than that of liquid-filled transformers principally because the kind of insulation used is not so critical to temperature as that used in liquid-filled transformers. The glass, asbestos, mica and porcelain insulation which is subjected to high temperatures in these dry type transformers can withstand widely varying temperatures without serious deterioration.

By the application of forced-air cooling, the capacity of these transformers may be increased from one-fourth to one-third. A thermally operated relay is available for automatically operating the fan when the normal operating temperature is exceeded. This relay is mounted in the cooling air stream where it leaves the winding ducts. The relay is supplied with a current through the thermal elements proportional to the transformer current. The relay accurately follows the winding temperature and in addition to controlling the fans gives an alarm if the maximum safe operating temperature is exceeded. Thus, the overall reliability of these transformers is increased under abnormal operating conditions.

These transformers have inherent advantages from the standpoint of maintenance because there are no liquids, no valves, no fittings or gaskets — nothing to leak. Thus, much maintenance expense is eliminated. In very dirty locations, an excessive accumulation of dirt must be removed. This may be accomplished easily and simply by removing the side of the case and blowing out the dirt with compressed air. Maintenance has reached an alltime minimum with dry type transformers.

Dry type air-cooled power transformers are lighter in weight and occupy less space than liquid-filled transformers of equal ratings. The transformers may be designed to facilitate the addition of isolating or load break disconnect switches and for direct connection to

low voltage and high voltage switchgear (Figure 6). By combining these devices and the transformer into one structure, the necessity for bushings and outside connections between units is eliminated and reliability and safety of operation are increased. They are particularly adaptable for industrial application and to network distribution systems — they may be placed where they do the most good, at the load-center with shorter cable runs.

Tests and an operating record of more than seven years gives ample proof that these modern dry type air-cooled transformers loaded under normal as well as abnormal conditions may be expected to give continuous reliable service.

DISCUSSION

PRESENTED BY

JOHN DEIMLER, Electrical Engineer, Alan Wood Steel Company, Conshohocken, Pennsylvania

G. R. WALTER, Chief Electrician, American Smelting and Refining Company, Baltimore, Maryland

W. H. BURR, Superintendent, Electrical Department, Lukens Steel Company, Coatesville, Pennsylvania

G. O. VAN ARTSDALEN, Maintenance Superintendent, Henry Disston & Sons, Inc., Philadelphia, Pennsylvania.

C. L. EICHENBERG, Experimental Engineer, Bethlehem Steel Company, Bethlehem, Pennsylvania

A. D. HOWRY, Electrical Engineer, Alan Wood Steel Company, Conshohocken, Pennsylvania

G. R. LOBS, Power Foreman, The Midvale Company, Nicetown, Philadelphia, Pennsylvania

E. L. ANDERSON, Superintendent, Electrical Department, Bethlehem Steel Company, Johnstown, Pennsylvania

M. B. ANTRIM, Assistant to Electrical Superintendent, Lukens Steel Company, Coatesville, Pennsylvania

W. W. SATTERLEE, Division Engineer, Westinghouse Electric and Manufacturing Company, Sharon, Pennsylvania

John Deimler: There is one point I think might be emphasized a little more. On these three-phase dry type units, in cases where you have a fault on one of the high voltage windings, have you found that it has affected any of the other windings at all, or has it been confined to the high voltage winding where the fault occurred? Compare this fact with the fact that on the three-phase liquid or oil filled transformer when you have a fault you usually lose the entire unit.

G. R. Walter: I was very much interested in these dry type transformers. The only thing, however, that disturbs me is how does the insulation withstand a corrosive atmosphere, sulphuric acid, etc.?

W. H. Burr: Among men in the operating departments of the steel mills, three-phase vs single-phase transformation has always been a debateable question. We are very much relieved, I am sure, to know that the reliability of the three-phase transformer has been very much increased and that we can possibly rest more comfortably with these three-phase transformers in service. When we were using single-phase transformers, failure in any one of them could be easily offset by forced ventilation and we could continue to operate the two remaining transformers in most cases without a shutdown in the plant.

In connection with the bimetallic relays in transformers, I feel that we in operating the department should emphasize the fact that, when any piece of auxiliary equipment of this kind is used in conjunction with transformers, it should be of the very best obtainable product and of such design that it will not cause false operation and produce more serious results than would have happened had the transformers not been protected with such equipment. In other words, make any auxiliary equipment absolutely dependable or don't use it.

In connection with the use of improved steel and the streamlining of the transformers, I might add that this change was brought to my attention recently when we installed two banks of modern transformers of increased capacity, and much to my surprise when they arrived on the job they were very much smaller than the transformers we had taken out. Until recently, with all of these transformers, we have had to use liquid in the transformers. In my opinion more trouble has resulted with the liquid used in the transformers than the windings, so the advent of the air-cooled transformer has many things which should prove advantageous to the operating personnel.

Mr. Satterlee has given us some very interesting information regarding the tests to which they have subjected these transformers and the almost unbelievable temperatures at which they have been and are operating. Possibly the most unusual thing in his discussion is that for once a manufacturer of equipment has actually told us they have failures with this equipment.

The one thing which has already been mentioned in connection with the air-cooled transformers, and which must be guarded against, is the atmosphere in which the transformers are actually operated. The result which may follow exposure to moisture which is so prevalent in many of the plants where we have had to operate transformers of this type may be very serious.

The fact that three out of four failures mentioned were due to flashovers seems to be encouraging, because it would seem to be possible to increase this clearance so that failures for that reason would not occur.

I would like to ask whether bimetallic relays are used to protect most of the transformers which are manufactured at the present time.

Is it possible that the standard temperature rise may be changed on air-cooled transformers when it actually becomes known that they can be subjected to and will stand such temperatures as mentioned this evening?

G. O. Van Artsdalen: I heartily agree with Mr. Satterlee that the great industrial expansion in the past few years has introduced some very serious problems with power equipment, not the least of which having

been with transformers and their loading or overloading safely.

The trend toward three-phase transformers is a step in the right direction particularly where new plants were built and new equipment has been installed. They very definitely conserve great quantities of critical materials and space, and when supplying a single load such as a furnace, rectifier or single machine are by far the most economical type to install.

We have purchased and installed a number recently to supply power to annealing furnaces, and have had installed for some time those which supply the melting furnaces from the 13 kv system. I feel, however, that I must say a word in defense of the single phase unit, inasmuch as we use many of them and under our present setup cannot do without them.

Since none of the manufacturers build two-phase transformers as standard equipment and our general low voltage power and light distribution is still all two-phase, we are forced to keep and maintain 15 banks, each consisting of two or four single-phase transformers for this purpose.

Also, in our tie between the 13.2 kv three-phase power supply and 2400 volt two-phase distribution, it is necessary to maintain two Scott-connected banks of single-phase transformers which are standard units except for the fact that a 50 per cent and an 86.6 per cent tap is brought outside the case.

The trends toward better core steel, more carefully designed circulation of the cooling medium and the use of external cooling attachments all lend themselves to great savings in materials and greater capacities.

With the step-up in loads and the addition of load above rated capacities, the maintenance problem becomes exacting and much closer supervision and inspection is necessary. A transformer operated on the borderline of safety normally requires constant attention and the addition of automatic alarm or control devices is a necessity. It is also necessary that these devices be very dependable.

Due to restricted circulation because of cell walls, we have found it necessary to add forced cooling to a Scott connected bank of 2,000 kva capacity. The upper section of each transformer was enclosed in sheet metal ducts properly vented and supplied with fresh air from the outside by two fans each. As this bank was carrying 100 per cent load, temperatures of 65 C to 70 C were common at the peak of the load on hot summer days. After the installation of the fans, the summer oil temperature never reaches 60 C.

We have had little experience with dry type transformers above 10 kva however, and I do not feel free to comment on them.

I would like to inquire as to the copper used. We have found that standard electrical copper subjected to high temperatures for a long period of time tends to crystallize and when subjected to shocks on vibration frequently fails mechanically. Is the conductor material used in the high temperature dry type transformer of a special quality — possibly copper alloyed with another metal?

The perfection of dry type transformers along with that of high voltage air circuit breakers is a very welcome thing for the operating man.

C. L. Eichenberg: I have been very favorably impressed by the high operating temperature which the air-cooled transformers are able to withstand. Can the ability to withstand these high temperatures be attributed to the use of silicone varnishes?

I would also like Mr. Satterlee to tell us the effect that highly magnetic steel mill dirt has on the operation of air-cooled transformers.

A. D. Howry: I followed Mr. Satterlee's discussion with a great deal of interest for the simple reason we have a dry type transformer installed at our plant, which has been in operation for nine months. The transformer is throat-connected to a 440 volt metal clad switch gear.

Mr. Satterlee answered one question that was paramount in my mind, that is, overload capacity and what hazard it presented to the operating personnel of the stations. I believe both of those points were answered.

G. R. Lobs: I wanted to ask Mr. Satterlee about the efficiency of the dry type transformer as compared to the oil transformer. Also how the impedence of the dry type compares with the oil or liquid type?

E. L. Anderson: The improvement in design of the oil type transformer where the core is built up from the bottom of a heavy base with the cover welded on is very desirable as it is of such construction that the transformer can be moved without danger of causing serious leaks between the case and the base.

Regarding the dry type transformer, I believe that this transformer has a definite place in industry, especially in powerhouses and substations of old design and where space limitations make it impossible to locate the transformer outside the building.

Oil insulated transformers present a fire hazard and although my knowledge of transformer failures is very meager, in most plants the insurance department requires that transformers be vaulted and protected with some sort of automatic fire extinguishing equipment.

We have recently installed fire extinguishing equipment on several large transformer banks in our plant and found it necessary due to the vaulting of the transformers to provide additional cooling. This we accomplished by circulating the oil through a heat exchanger. The oil is carried at a higher pressure than the water so that any leakage will be from the oil to the water and not from the water to the oil. This system has been giving us very satisfactory results.

M. B. Antrim: Is it impossible to build large air-cooled transformers in a shell form? Since there is a division point between core and shell form transformers as the capacity increases, it would be interesting to know what the present day limit on the air-cooled transformer might be, as far as capacity is concerned.

W. W. Satterlee: The first question by Mr. Deimler was — "If a fault occurs in one H.V. winding, are the other windings affected; in other words, what may happen to the entire transformer?"

If a failure occurs in any transformer whether of a liquid-filled or a dry type design, obviously something happens and usually some part of it is damaged. In a liquid-filled transformer, because of the presence of cellulose insulating materials and a liquid, whether oil or a noninflammable liquid, arcing causes rapid decomposition of the insulating materials and the liquid. Because of the presence of the liquid, the failure is likely to spread.

In the dry type transformers as described in the paper, first, the insulating materials used are to a large extent inorganic, and second, there is no liquid present to conduct or feed the arc. For these reasons, a failure in these dry type transformers, and I admitted some failures have occurred, is not likely to spread or affect more than a part of one winding — it is usually localized at the point where breakdown occurs.

If arcing occurs across a bushing or between windings, the flashover is more like that of a line insulator. If, when testing a dry type transformer, the test voltage is raised to the point of breakdown little or no arcing occurs because there is little or nothing to burn. In fact, the test can usually be repeated at or near the same value of voltage. In our experience, when arcing has occurred in these dry type transformers, except in one case of a severe lightning surge, it was necessary to repair only the part affected by the localized breakdown.

The second question was asked by Mr. Walter, and it is perhaps one of the more difficult to answer completely. It relates to the effects corrosive acid atmospheres may have on the insulation. Over 2000 transformers are installed in many different locations: some are in steel mills; others are in foundries; some are in mines; and others are serving many different industrial applications. No trouble has ever been reported with respect to the effects of a corrosive atmosphere.

In industrial applications people frequently work at or near the place where the transformers are installed. If the atmosphere is such that people can remain in it for any appreciable time, it seems unlikely that it would affect the insulation in the transformers. Also, as long as the insulation is at a temperature above that of the atmosphere, it is doubtful if gases would cause deterioration of the insulation. Sulphuric or nitric acid gases in sufficient concentration, in the presence of moisture might detrimentally affect the insulation and corrode exposed copper parts.

Answering Mr. Burr's comments, three-phase transformers have been used to a much greater extent during the past few years. This is due not only to the need of conserving materials but also because of the quality built into transformers today. I have only briefly touched on the many improvements made during recent years in the design and construction of transformers which add greatly to their operating reliability.

Mr. Burr pointed out the need of having dependable transformer accessories. He referred to the bimetallic relay. We make this relay in different types but basically they are the same for application to transformers to provide a means of loading the transformers by copper temperature. The development of this relay presented many problems. Today, thousands are giving reliable and dependable service.

Another point mentioned is the continued operation of dry type transformers in humid and dirty atmospheres. The answer to this, I think, is pretty well covered in my paper. I will mention that operating experience indicates very little accumulation of dirt in the windings of these transformers after three or four years operation over what may collect within a few months to one year. The windings are designed and assembled so that very little dirt can accumulate on surfaces in high potential areas. It is a simple matter to blow dirt out of the transformer by the use of compressed air.

Mr. Burr also asked if the rating of these transformers could be increased because of operation at higher temperatures. The answer is "no," as the transformers are designed to carry their rated load at an average winding temperature rise of 80 C just as liquid-filled transformers are usually designed to an average winding temperature rise of 55 C at rated capacity. The dry type transformers I have described will operate at higher temperatures than liquid-filled transformers because they are insulated with class B insulating materials which to a large extent are inorganic substances and because of the manner in which the transformers are constructed.

Mr. Van Artsdalen asked "Does the copper used in these dry type transformers have a special alloy in it to withstand the higher operating temperatures?" The copper is not a special alloy and the transformer windings do not reach excessive temperatures under rated load or at overloads to which transformers are often subjected. Perhaps Mr. Van Artsdalen misunderstood me. I pointed out that these dry type transformers had been subjected to overloading under test conditions such that their windings reached a temperature of approximately 400 C. However, at rated load, the windings would seldom exceed a maximum temperature rise of 115 C. Such a temperature will not cause the copper to crystallize.

Mr. Eichenberg asked if the higher temperatures are the result of using silicone varnishes. The varnish used in these transformers is a special heat-resistant varnish but it is not a silicone varnish. Silicone varnishes are relatively new and not yet used commercially to any great extent, at least for treatment of transformer windings. However, it is probable that increasing applications of silicone varnishes will be made as they will withstand higher temperatures than the varnishes commonly used now. Many new insulating materials are being developed which may be suitable for use in transformers or other electrical apparatus designed for high temperature operation.

Mr. Lobs asked "How does the efficiency and the impedance of these dry type transformers compare with liquid-filled transformers?" The full load efficiency of these dry type transformers is approximately the same as that of liquid-filled transformers of the same ratings. The iron loss of the dry type transformer ranges from perhaps 5 to 15 per cent higher than that of liquid-filled transformers, while in most cases the copper loss of the dry type transformers is lower. These dry type transformers are designed to have approximately the same impedance as liquid-filled transformers of the same ratings.

Answering Mr. Antrim, it is possible to build large dry type transformers using a shell-form core. In fact, the develop ment of dry type air-cooled transformers as such is not new and most of the older dry type airblast transformers were of shell-form design and constructed with class A insulating materials.

The air-cooled transformers I have described are of core-form design and they are insulated with class B materials. At present these transformers are built in self-cooled ratings as large as 4000 kva, three-phase, and in voltages as high as 15,000. Forced air-cooling may be supplied to increase their rating from ¼ to ⅓.

Coke Oven AND Blast Furnace Operation

. . . . perhaps no other unit in a steel plant is influenced so much by so many little, yet important, items as is the blast furnace . . . . uniformly good practice requires careful attention to these details . . . .

by J. B. Hill

SUPERINTENDENT, BLAST FURNACES

BETHLEHEM STEEL COMPANY

LACKAWANNA, NEW YORK

▲ THE subject of coke oven and blast furnace operation is too large to be discussed in much detail in a single paper. We shall endeavor, however, to look at the broader aspects and more important details. With given raw materials and any particular plant, the success of the operation depends largely on meticulous attention to a vast horde of details. However, as we are considering only the general picture, we shall talk only of some of the larger items that concern the operation of a coke oven and blast furnace plant.

In a well integrated steel plant the prime function of a coke oven plant is to supply coke of the best possible quality for use in the blast furnaces. The prime function of the blast furnaces is to produce pig iron which is one of the raw materials from which steel is made. Blast furnace operation is largely influenced by the quality of coke used in that operation. Thus it is seen that, while they are two distinct and separate operations, there is yet a strong link between the two.

What is meant by "coke of the best possible quality?" This is a relative term, to a large extent dictated to by the economic aspects of a particular operation. For instance, in American practice we have successful blast furnace operation with cokes ranging 6-13 per cent ash and 0.6-1.8 per cent sulphur, with 2 in. shatter index of 50-80 per cent, not to mention a very wide range in specific reaction rates to oxygen. The reason, of course, for these extreme ranges is found in the fact that each plant is dependent on coals available to that plant at a cost that will produce a profitable operation. In spite of the fact that the coke oven operator has considerable control of coke quality in his operation, it is the quality of the coal used in that particular operation that largely determines the quality of the coke that will be produced.

The most important axiom of good coke oven and blast furnace operation is uniform raw materials. This point cannot be emphasized too strongly and is particularly true in the case of coal to be used for metallurgical processes. A coke oven and blast furnace operation can be set up that will successfully make use of coal and coke of almost any quality, within certain limitations. However, day-to-day variations in quality must be very small, because large variations cannot be assessed in time to make correct adjustments, and loss of pig iron

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tonnage and quality will result. Due to the greatly expanded steel requirements resulting from the war, the normal fuel situation for metallurgical processes that existed before the war has been upset at a number of plants in the country, and the coke oven and blast furnace operator has been forced to use coals which gives anything but a uniform coke. A better record of achievement would have been attained at these plants had this fact not existed.

It would be interesting to trace the history of the operation of coking coal from the time when pits were dug in the ground in which log fires were built and, after being partially burnt out, were filled with coal and covered over with earth, leaving only small openings at the top through which the escaping gases and smoke from the coking coal could escape. These pits closely approximated the beehive ovens which followed shortly thereafter. About the only difference between the two was that the beehive oven was built above ground level, of dome shape and constructed of brick, a hole being left in the top for charging the coal and to provide an exit for escaping gases. The coke was pulled out by hand through a door in the side of the oven. Later, at some plants, these ovens were built in rectangular shape and were mechanized to the extent that they had machines which pushed or pulled the coke out of the ovens. A great many beehive ovens are operating at the present time, but that is only due to the unprecedented demand for coke resulting from the present emergency. Around the turn of the century the byproduct coke oven, somewhat as we know it today, came into being as a major producer of blast furnace fuel. Great strides have been made in its design, operation and auxiliary equipment since that time.

When byproduct coke was first introduced as a blast furnace fuel a whole new technique had to be developed for blast furnace operation with this fuel. Also, most coke oven operators knew little or nothing about the requirements for blast furnace coke and to make matters worse the furnace men themselves could not specify what was desired. There was a long period of "cut-and-try" procedures in both oven and furnace operations before a well-ordered technique was finally evolved. At the same time chemistry, metallurgy and a more profound application of engineering principles began to be applied to blast furnace operation. With this scientific and technical approach came the explanations of some of the strange behavior that blast furnaces exhibited. Heretofore, some actions were so strange that blast furnace men always referred to their furnaces in the feminine gender, thus tacitly admitting their inability to understand them. No small contributor to these unaccountable actions was variable coke quality.

Only rarely is just one type of coal used in a byproduct oven. Usually two or more grades of coal are mixed in very definite proportions, not only for economical and metallurgical reasons but also to give certain desired characteristics to the resulting coke. Each grade of coal has certain coking characteristics, and variations in the proportions of the various coals contained in the mixture to the ovens will in itself change the quality of the coke produced. And when we make that statement we are assuming that there is no variation in each individual grade of coal. This, of course, we know is not the case. Each detail of the operation of coke ovens has its effect on coke quality: degree of pulverization (that is, the percentage of coal passing through an $\frac{1}{8}$ in. screen), amount of moisture in the coal as charged, temperature of the ovens, length of coking time, regularity of the pushing schedule, manner of quenching and the amount of water used, the carefulness of sizing and screening and the way in which the coke is handled from the time it leaves the coke plant until it is dumped into the top of the blast furnaces — these and many other details affect the quality and character of byproduct coke.

At this point it would be in order to specify what are the ideal requirements of a good coke for a blast furnace. There are too many problems concerning the economics of producing pig iron involved in this question, as we have pointed out before, but let us make this broad statement: A byproduct coke should be hard, of uniform character and produced from coals that are available at a cost consistent with a profitable operation.

In the shaft of a blast furnace the coke is charged so as to form a bedded or layered structure which carries the ore and stone burden. This column of materials moves down through the furnace, the materials of the burden undergoing chemical reaction while the supporting structure of the coke is only slightly attacked. As the stock column moves downward, the materials of the burden are reduced and melted, forming iron and slag, and as the coke reaches the tuyeres it is burned, forming gas and giving up its ash to the already forming slag. The combustion of the coke supplies the essential heat which is transported by the flowing gas to the higher levels of the furnace at which points the reducing reactions occur. The proper transport of this heat depends on the permeability of the stock column, which in turn is determined by the size, shape and distribution of the channels within the stock column.

There are three principal things that determine the openness of the stock column: First, the hardness, or size stability of the coke and its sizing; second, the charging sequence of the raw materials; and third, the sizing of the ore and the limestone.

It is important to have uniformly sized coke so as to be able to control the volume of voids among the pieces of coke. Size stability is important because it is essential that, in the downward movement of the stock column and the attendant grinding action of the materials against each other, the size of the pieces of coke is not materially reduced until they are burnt at the tuyeres, thus maintaining the uniformity of the void size throughout the furnace. It is frequently necessary for the furnace operator to use in his furnace small sized coke, $\frac{3}{4}$ to 1 in. These sizes, it has been found, can be used successfully if they are charged into the furnace in layers instead of being mixed in with the larger sized coke. All coke should be thoroughly screened so as to remove all coke braize before being charged, as this fine dust not only clogs up the stock column, causing excessive pressure and irregular working, but also contributes to solution loss in the furnace which results in a higher coke consumption per ton of iron produced.

The effect of the charging sequence upon the stock column is intimately connected with the distribution

of the materials of each charge in the furnace. The success of the entire operation depends on proper distribution. Ore, limestone, coke and any other materials must be deposited evenly on the big bell. This is largely a matter of mechanical design. The big bell should be evenly balanced, should be located on the center line of the furnace and should drop away from the lip ring of the hopper all around the circle at the same instant. If this is not the case, then there will not be an even distribution of stock all around the periphery at the stock line. On a horizontal plane through the furnace each quadrant should contain the same amount of each of the various materials being charged into the furnace. This is not true, though, if we examine the unit quantities along a diameter of this plane. A greater portion of the ore will be found against the walls of the furnace, decreasing as we approach the center of the furnace. Experience has shown that this is as it should be.

The aim in charging the materials into the furnace at the stockline in layers is to get the best possible contact in the stock column between each piece of ore, coke and limestone and the ascending hot gases, so that the solids will be evenly preheated across the whole plane as they descend through the furnace. For any given furnace and with the raw materials available to that furnace, it very frequently requires much experimentation on the part of the operator before a satisfactory solution to the problem of distribution has been reached. The charging sequence and speed of dumping the big bell plays no small part in this solution.

While the materials comprising the stock column are descending through the furnace they are being subjected to a great many chemical reactions from the ascending hot gases. The farther down the furnace they go, the greater the acceleration of these reactions, due to more sensible heat in the gases. A recital of these reactions, though pertinent, is not necessary in this discussion.

Let us consider the condition of the stock after it has reached the bosh of the furnace. Practically all the iron ore has been reduced to metallic iron intimately mixed with whatever gangue material was contained in the original ore. The limestone has been completely calcined. The coke, we will assume, has arrived at this zone unchanged. There is sufficient heat in this zone to melt all the materials except the coke, and liquid iron and slag which are being formed trickle down into the hearth of the furnace and form a pool of molten material which will be withdrawn when necessary. It is obvious that due to its specific gravity the iron is at the bottom of the pool, the slag staying on top. At the tuyere zone the coke is consumed, forming the hot gas which is the reducing agent of the furnace; the ash of the coke passes into the already forming slag and gives that slag its final characteristics.

It might seem strange to the uninitiated, but the furnace operator is more immediately interested in the slag formed than he is in the iron. The slag is a by-product, yet the slag is responsible for the final, and it can almost be said the only, purification of the iron. Unless the slag has certain characteristics (and these characteristics vary according to the requirements necessitated by the raw materials) the proper quality of iron cannot be produced. Also the slag has some considerable effect on the tonnage produced by a furnace. In general, the leaner the slag, the faster the furnace can be blown and the more iron produced. However, this is not the sole factor limiting production. The character of the slag is the determining factor in the control of the sulphur, silicon and to some extent the manganese contained in the pig iron. It has some effect on the proportions of combined and graphitic carbon and hearth temperature, this last being very important not only to the operation of the furnace itself, but also in the subsequent handling of the iron to the steel producing units of the steel plant.

In the case of sulphur elimination, the slag volume — that is the amount of slag produced per ton of iron — is particularly important. Slag volume also has a very decided bearing on the smoothness of the furnace operation. Too low a slag volume ("dry furnace" as it is often called) is conducive to an irregular working furnace.

The principal constituents of blast furnace slag are lime, silica, alumina and magnesia, ranging in importance in about the order named. The blast furnace operator's problem is to produce a slag of such composition that it will have the lowest free-running temperature consistent with adequate sulphur removal. The proportioning of ores in the burden for the control of silicon, phosphorus and manganese is of course important, especially in the production of foundry and malleable irons; yet it is the problem of slag control that generally spells the difference between good or bad iron.

We have dwelt at some length on the processes occuring in and concerning the furnace itself. After all that is the heart of a blast furnace plant, and all other operations, although of vital importance, are still of an auxiliary nature. The raw material handling facilities, consisting of coke handling, ore yard layout, car dumper or boat unloading equipment, ore bridges, bin systems and ore distributing and charging equipment should be adequately designed to handle with ease the large quantities of materials that are daily charged into a blast furnace. A modern furnace operating on Lake ores and producing around 1400 tons of pig iron daily will require approximately 4900 tons of solid materials each day. The handling of this quantity of materials is no small task, and when it is remembered that each kind of material has to be charged into the furnace in exact amounts and that they have to be available at all times, then some idea of the requirements demanded of this equipment becomes obvious.

Blast for the furnaces is supplied by blowing engines of the steam or gas reciprocating type or by turbo blowers. Here again, for best operation, exactness of control is necessary. The power required by these engines is great, as in normal modern blast furnace operation blast pressures from 18 to 25 psi are the rule, and it takes approximately 4 tons of air to make a ton of pig iron.

Blast to the furnace is preheated from 800 F to 1400 F in the hot stoves. There are many different types of stoves used today in blast furnace plants, and the principal variations are in the shape and size of the checker opening, in the style of brick shape used and the amount of heating surface exposed. There is a particularly good field in stove design for bricks of various compositions and at most plants advantage has been taken of the availability of the numerous special pur-

pose bricks (sometimes referred to as superduty bricks) to increase stove life and minimize stove repairs. We are particularly partial to a design that uses standard shapes, the economy being apparent.

The gas produced in a blast furnace and withdrawn from the top is a valuable fuel that is used to preheat the blast, generate steam, operate gas engines, underfire coke ovens and heat steel at rolling mills. Before being used for these purposes it must be cleaned. The amount of cleaning required varies according to the different uses to which it is put. In no case, however, should its dirt content be greater than .06 grains per cu ft, and when it is to be used for purposes such as a fuel to operate gas engines, its cleanliness should be about .001 grains per cu ft or less. This is almost as clean as the air we breathe. The gas cleaning and distributing system comprises no small part of the investment of a modern blast furnace plant.

No discussion concerning operations of a blast furnace would be complete if it did not bring up the question of the human element and the very vital part it plays in the production of pig iron. We wish to quote, in part, from a paper presented by H. A. Brassert before the American Iron and Steel Institute some years ago, in which he expressed so ably the part played by the human element: "To achieve uniformly good practice nothing is more essential than the building up of an intelligent, watchful and active furnace organization . . . being continually in close contact with the furnace, they must be relied upon to watch the many little, yet important details of operation. The furnace manager who fails to devote as much of his thought and energy to studying and improving his organization as he gives to correcting the design of his plant, misses one of his best opportunities. Any effort on his part to instill into his men a keener interest in the efficiency of the plant will make his task the easier . . . In no branch of industry is the exchange of experience more helpful and necessary to progress than in blast furnace work."

DISCUSSION

PRESENTED BY

HARRY S. OWENS, Superintendent of Plant Operations, Donner-Hanna Coke Corporation, Buffalo, New York

R. K. GLASS, Assistant Chief Metallurgist, Republic Steel Corporation, Buffalo, New York

J. B. HILL, Superintendent, Blast Furnaces, Bethlehem Steel Company, Lackawanna, New York

Harry S. Owens: The making of coke is most important as it ties in directly with the operation of blast furnaces. Admittedly, the quality of coal used largely determines the quality of coke produced. We can expect, however, that new coals must be tried; coal sources are subject to change; individual grades of coal will vary; and we are confronted with ever changing coal conditions. The coke oven operator endeavors to make coal adjustments in such a manner that variations in the finished coke will be held to a minimum, knowing that the blast furnace requires uniform raw materials and particularly uniform coke. More can be achieved along this line than is at first apparent.

This leads to a discussion of those factors, which when properly controlled, should guarantee a uniform coke product.

1. We aim to obtain suitable coking coals of good chemical analysis. A portion of our coal mix (20-25 per cent) is made up of low volatile, which type generally speaking improves coke structure. These coals are far from being plentiful. As a wartime substitute a small percentage of anthracite fines has been used consistently and successfully in our coal mixes for many months.
2. The proper blending of coals for coking will greatly aid in making a coke of the best possible quality. Good coke should not show day to day variations; a uniformity of coke is demanded. A number of mixing bins for blending coals is most advantageous. More coal through more bins will smooth out irregularities.

   Frequently coke is made from one high and one low volatile coal. Coke can be made from one high volatile coal alone. To obtain all coal from one or two sources is hardly possible and not advisable for most operations. This condition makes it imperative that we blend a number of coals and that the job be well done by using the proper facilities. For such control at Donner-Hanna, we are fortunate in having six coal mixer bins, and six different coals may be used proportionately in a blend. Radical changes are to be avoided.
3. The coal mix should be pulverized to a fineness sufficient to prevent segregation of sizes in the main coal bin located above the ovens. In this bin is stored the pulverized coal to be charged into the individual coke ovens. Fine coal at the center of an oven with relatively larger particles at the ends will vary the coke strength, and if pronounced, will cause operation difficulties. Wide variations of moisture in the coal also cause coke variations. This can be offset to some degree by the application of oil to the coal, which is helpful in keeping the density of the coal charge fairly uniform.
4. Heating control of coke ovens involves much detail and time will not permit full coverage. Oven heats should be regulated for uniformity, and we like to see the finished coke on the "warm side."
5. The individual coke ovens are pushed, or emptied, on a regular time schedule. For instance, we push our ovens at 4¼ minute intervals after an approximate 14 hour coking cycle for each oven. Lengthening of coking time beyond certain limits will change the coke characteristics somewhat. This is not a factor today with full speed operation. The avoidance of any rapid up or down variations in pushing schedule is important in order to make all the coke at even heats. Oven equipment must be well maintained and repairs anticipated to avoid pushing delays.
6. The quenching of coke is another important factor. The hot coke from the ovens should be completely quenched to remove the last trace of fire, using the minimum of water in such a way that as little as possible is retained in the coke.

7. As to the sizing of the coke, we prefer controlled sizes for the blast furnaces — that is, controlling the top size by light crushing, and the bottom size by doing a thorough screening job. At Donner-Hanna we prepare two sizes, furnace and nut. These are used separately as the blast furnace operator determines.

In addition to the factors discussed it is also necessary to watch the finished coke product in terms of chemical analysis, strength and porosity. We believe that, with a fairly good observance of operation details and with particular emphasis on coal blending and preparation, a reasonably uniform coke product can be expected.

R. K. Glass: Mr. Hill's paper is not only very interesting as to the development and the importance of the control of raw materials, but also timely due to the ever increasing economic and quality demands placed upon the blast furnace, and particularly the product that the blast furnace produces, namely, pig iron.

Unfortunately, the blast furnace has not come in for the same amount of technical study and control as given to the production of steel, even though it occupies the first position in the processing of raw materials for the production of steel. The blast furnace is the least understood and the most neglected, and yet it is the most important unit in steel production. Without it the steel industry would still be in the formative state.

In passing from the use of beehive coke to byproduct coke, the blast furnace operators have shown that they could, when economic changes demand, adopt the changes necessary to utilize a new material of different physical characteristics.

As I said, we are interested particularly in the product the blast furnace puts out. In producing steel we stress production and quality control. On top of that today we have a greater demand for higher quality in pig iron, the ultimate product of the blast furnace.

There was a time when we broke a pig in two, you looked at it, you got within 75 points of silicon, and that was all right. Now, today there is an ever increasing demand for close chemistry limits and, at the present time, there is a committee working on more rigid specifications for pig iron.

There has been much said concerning the possible exhaustion of our reserves of the high grades of iron ore. That means we are going to have to utilize whatever grade of ore is available. It means a greater job to be done in the operation of the blast furnace as operators and as engineers.

I want to ask one question. Mr. Hill mentioned the control of carbon in blast furnace operation. We are all interested in that, whether or not it is in saturation due to silicon, and we have certain theoretical ideas about slag volume in variation to slag temperatures. I would like to have Mr. Hill amplify the subject.

J. B. Hill: I wish I knew more about the control of carbon. We have done some work on it, but there isn't too much known about how to control the form that carbon exists in, whether it is graphitic or combined. Our experiments seem to indicate that there are certain factors that do exert a control. However, I do think that it is only a question of time before the foundry people will be writing into their specifications certain specifications on carbon, and I think it behooves the blast furnace fraternity to find out something about it.

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by P. V. FARAGHER

MANAGER, METALLURGICAL DIVISION

ALUMINUM COMPANY OF AMERICA

PITTSBURGH, PENNSYLVANIA

▲ BEFORE discussing the recent advances in aluminum to an audience whose welfare depends upon the success of the steel industry, it may be well to look at the possible threat to your future that is presented by the much discussed newcomer in the field of structural materials.

A discussion of the nonferrous metals published in a recent trade journal stated that at the beginning of 1941, aluminum was being produced at the rate of about 600,000,000 pounds per year. This rate of production represented an increase by private industry just less than double the maximum peace year production of 327,000,000 pounds.

Edward R. Stettinius, Jr., then commissioner in charge of the Industrial Materials Division of the National Defense Advisory Commission, is quoted as stating that "Investigations just completed disclosed no serious shortages of aluminum supplies for aircraft and other military items now required for national defense."

However, estimated requirements were rapidly revised upwards and production capacities were increased to keep pace with the demand. Further expansion by private industry, augmented by Defense Plant Corporation plants, brought the production rate up to 2,200,000,000 pounds per year during the last three months of 1943.

A review of the estimated requirements indicated that production had more than met the military demand and the manpower situation precluded the general release of the metal for civilian needs. Consequently, primary production was cut back to about 1,500,000,000 pounds for the year 1944. During this same year, the secondary aluminum ingot production was about 600,000,000 pounds.

The DPC-owned, Alcoa-operated plants at Maspeth (Queens), N. Y., Burlington, N. J., and Riverbank, Cal., have been closed and declared surplus; those at Torrance, Cal., and St. Lawrence, N. Y., have been closed and placed in stand-by condition, and in those at Spokane, Wash., Troutdale, Ore., and Jones Mills, Ark., production has been cut back as well as in the Alcoa-owned plants at Vancouver, Wash., Badin, N. C., and Alcoa, Tenn.

Some of these plants were using power originally developed to serve New York, Philadelphia, San Francisco and Los Angeles, and might not be expected to compete in peace-time industrial production of aluminum which requires about 10 kwhr per pound of metal which in the form of ingot sells for 15 cents.

Translating these figures into tons per year, the way steel production is given, we find that the production of aluminum during 1944, including secondary ingot, was about one million tons. This is to be compared with a steel production upwards of 90,000,000 tons, a little more than one per cent.

Consider also that a substantial percentage of the peace-time use of aluminum is not in the structural field, and consequently not competitive with steel — for example, aluminum cable for power transmission which incidentally has a core of galvanized high tensile steel, aluminum foil, much of the chemical processing equipment and aluminum used for metallurgical processes such as deoxidation of steel and reduction of refractory metal oxides.

Having disposed of any misgivings that you may

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have entertained, we may proceed to consider the developments in the aluminum industry during the war years and to look at the future uses for the metal when it is again available for peace-time uses.

One of the first problems that had to be taken into account in the sevenfold increase in aluminum production was that of electric power. Fortunately, the Bonneville development was completed and Alcoa had undertaken its expansion in the northwest prior to the outbreak of the war. The company had also undertaken the development of two power sites in the Little Tennessee valley to make more production possible at its Alcoa works. Later, the operation of all of those power sites was coordinated with that of the Tennessee Valley Authority so as to make possible the maximum total production of power in the entire watershed.

As the estimated requirements were further increased, it was necessary to consider other sources of electrical energy. In Arkansas, an installation of gas engines was made to take advantage of the low cost natural gas in that area, locating the reduction plant near the source of the raw material from which the aluminum would be produced. Also steam power was contracted for and reduction plants built near New York and Philadelphia, since the same economic considerations did not enter when aluminum was required for the war emergency as would govern for peace time production. Additional power was located in California and two reduction plants were located there.

The next problem was that of adequate supplies of bauxite, the mineral from which aluminum is produced. Before the war, the bauxite used for production of the metal came from Surinam (Dutch Guiana) and from Arkansas. The activities of German submarines made uncertain the supply from South America and the supplies of high grade bauxite required for the Bayer purification process are not unlimited in Arkansas.

It should be stated that in the production of aluminum, bauxite, which is a hydrated aluminum oxide contaminated with various impurities (notably silica, iron oxide and titanium oxide), is first purified to form pure aluminum oxide. The purification process consists in treating the finely ground bauxite with hot caustic soda solution which dissolves the aluminum hydroxide to form sodium aluminate. The impurities, which are not dissolved, are filtered off and the aluminate liquor is pumped to large tanks where aluminum hydroxide is precipitated as the liquor cools. The aluminum hydroxide is washed to free it from caustic soda and then calcined to drive off the water and change its form so that it will not reabsorb water during transportation and storage.

During the digestion process, any silica which is present in the bauxite reacts with the sodium aluminate to form an insoluble sodium aluminum silicate. The formation of this compound not only reduces the extraction of alumina, but also robs the liquor of an equivalent amount of sodium hydroxide. For that reason, only those deposits of bauxite that were low in silicon were suitable for the production of the metal.

Prior to the war a process had been developed for the purification of bauxite which could be used with low grade bauxite containing silica in percentages more than twice that which was considered economically practicable for use in the Bayer process. While this process had been operated only on a pilot plant scale, large plants were constructed and while some difficulties were encountered in the early stages, this process made available large deposits of bauxite in Arkansas and Georgia which otherwise could not have been used.

The metal is reduced by passing a current of electricity through a bath of molten cryolite in which the pure aluminum oxide is dissolved. At the anode, which is a block of carbon, oxygen is liberated and since the bath operates at a temperature upwards of 1800 F, the oxygen unites with the carbon to form oxides which escape. Approximately three-quarters of a

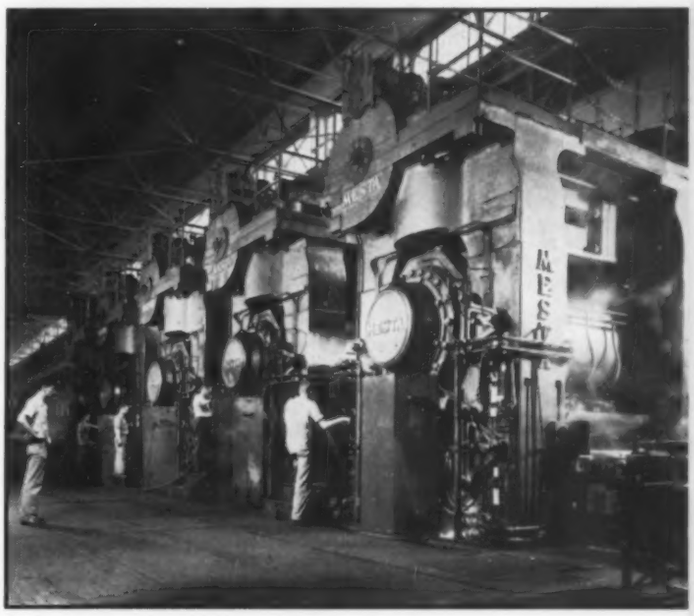


Figure 1 — Large scale production of aluminum sheet was made possible by continuous wide strip mills essentially duplicating those used for steel.

Figure 2 — Aluminum strip from the continuous mill passes over a long runout table just as in the steel mills. Note fans suspended over table for cooling the strip.

pound of carbon electrode is consumed for each pound of aluminum that is produced. The carbon lining of the steel cell in which the reaction is carried out is the anode, and the metal is deposited in the bottom of the cell as the current leaves the solution. Since the process operates at a temperature several hundred degrees above the melting point of aluminum, the metal collects as a liquid and is tapped off at regular intervals. As the bath becomes depleted in aluminum oxide, more is added and the process goes on continuously.

Since the carbon electrodes are consumed during the reduction process, any impurities in the carbon will dissolve in the bath and will be reduced to contaminate the aluminum. It is necessary to use petroleum coke in the manufacture of electrodes in order to keep down this source of impurities. It goes without saying that large electrode plants had to be constructed to supply the enormous demand of the augmented aluminum program.

The only commercial deposit of cryolite in the world is in Greenland. While cryolite is not consumed in the reduction process, large quantities were required for the new plants and there is some wastage which makes necessary small additions at regular intervals. The importation of this essential material would have imposed a difficult burden on the already overtaxed shipping facilities. A process for making artificial cryolite, using readily available raw materials, relieved an otherwise difficult situation.

The greatly augmented reduction capacity made necessary the construction of fabricating plants to convert the aluminum pig into the various alloy products required for the building of airplanes and other equipment for which the use of the metal was approved. Here also the expansion program of Alcoa begun before the war — in fact, before the depression was over — came to the rescue. The new facilities were not sufficient for the estimated requirements, but in those plants improvements in methods and in equipment had been made so that it was necessary only to build additional units like those already in operation.

The most revolutionary change came in the manufacture of sheet, where modern high speed four-high mills — the same as those used in the production of steel sheet and strip — replaced the old two-high mills. The rolling ingot increased in size from 265 pounds to 3500 pounds. The key to this change lay in the development of a process for casting a metallurgically sound ingot of a size that could be used economically on these modern mills. The solution to that problem had been found in the direct casting method well before the outbreak of the war. Also, the continuous strip process had been worked out on old two-high continuous mills that had been rebuilt to prove that the process was feasible with aluminum, as it had been found to be with steel. In the direct casting method, the molten alloy is poured into a shallow mold and, after a shell has been frozen, the ingot is slowly lowered through the mold with suitable cooling, while molten metal is added continuously till the required length is obtained.

The solution of the problem of producing a satisfactory ingot also made possible the production of bars and shapes starting in a blooming mill and finishing in modern rolling equipment, the same as that used in the steel industry. Similarly, the production of larger and heavier extruded shapes, using presses of larger size and capacity, increased the application of this class of material.

Probably the largest increase in production was in aluminum alloy forgings. The requirements for airplane fittings and engine parts brought the tonnage to more than 100 times the prewar level.

The increased volume of production had the effect of lowering manufacturing costs and there has been a decrease in cost of aluminum ingot from 20 cents to 15 cents per pound, and an even greater reduction in the cost of fabricated products, reflecting the improvements in manufacturing methods.

As you probably know, a large pcecentage of the

Figure 3 — As a result of war demands, the production of aluminum forgings, as typified by this aircraft crank case, increased more than that of any other fabricat ed product.

▲

Figure 4 — Aluminum for side, end and slope sheets and for certain other parts in this hopper car resulted in an 18 per cent weight reduction.

aluminum has gone into airplanes and airborne equipment. In this field, an increase in mechanical properties of the structural materials is promptly reflected in increased speed and performance. There have been striking developments in the field of aluminum alloys in response to this demand. An alloy recently announced, 75S, has typical tensile strength upwards of 80,000 psi and a yield strength over 70,000 psi. These properties represent substantial increases over those of 24S, the alloy that has been generally used. The new alloy is already being designed into new models of planes to further increase the superiority of our fighting craft and the carrying capacity of our transport planes.

Another alloy sheet product with higher tensile properties than those of 24S is Alclad 14S-T or, as designated by Reynolds Metals Company, R301. This sheet has a core of the same alloy as is widely used in high strength forgings, with surface coatings of another high strength alloy that has a superior resistance to corrosive attack and is also anodic to the core, so that it offers electrolytic protection in addition to preventing access of corrosive agents to the less resistant core.

All of the higher strength aluminum alloys have this quality by virtue of heat treatment processes. Certain of the alloys (like 14S) require a two-stage heat treatment to develop their maximum strength, first quenching from a temperature just below the melting point of the alloy eutectic, followed by aging at temperatures upwards of 300 F. The forming qualities after the quenching operation are much superior to those after aging at elevated temperatures. Such alloys offer the advantage that they can be formed into quite complicated shapes in the "as quenched" condition and the aging can be carried out on the finished part.

It has been found that 24S alloy also responds to elevated temperature aging treatments, and that the improvement in strength is greater if the alloy is strain hardened slightly by cold working after it has been quenched from the heat treatment temperature. The strain hardening may be introduced by rolling or by stretching by amounts from one to six per cent of the original thickness or length respectively. Using Alclad 24S sheet in order to retain the advantages of maximum resistance to corrosion, properties substantially the same as those of Alclad 14S are obtained.

Following this summary of the development brought about by the war, it may be of interest to consider what the situation will be when aluminum is no longer needed for military equipment. How long will it be before civilian requirements absorb the greatly increased production, and to what uses will it be put?

Before the war, definite progress was being made in the structural applications of aluminum. Because of its higher cost, aluminum alloys are used in preference to steel only in those applications where its use offers sufficient advantage in performance, in lowered maintenance, or in lowered operating cost to justify a higher initial cost.

Although aluminum structural alloys have strengths comparable with those of ordinary steel or even of the low alloy steels, their modulus of elasticity is only about one-third as great. It is therefore not usually possible to substitute aluminum for steel, section for section, but the structure must in most cases be designed to take account of the greater defection produced by equal loading. Consequently, it is rarely possible to realize the weight saving that would be expected from the ratio of the specific gravities of the two materials, i.e., 1.8 lb for each pound of aluminum alloy used in place of steel. A review of the various structural uses of aluminum before the war indicates that after redesign, the saving is more nearly a pound to a pound and a quarter of weight saved for each pound of aluminum used. At prewar prices, the cost of this saving varied from about ten to twenty-odd cents per pound depending upon the particular design. With present prices, these costs will be appreciably lower.

Two other factors will tend to favor the use of aluminum. One of these is the greater knowledge of the properties of aluminum alloys that has been acquired by designing engineers from the design of military equipment. The other is the greater number of shops that have become familiar with the handling of aluminum alloys. In many cases, lower costs of construction with the light alloys will partially offset the higher material cost.

Before the war, aluminum construction had become commonplace in the field of transportation. The increased pay load in busses and trucks, made possible by light weight construction, was sufficient to pay for the difference in first cost in relatively short periods of operation. Railway passenger cars made largely of aluminum or of composite aluminum and steel construction had already proved the advantages of light weight equipment.

Other uses include cranes, dragline booms, portable tools, machine tool applications, as well as reciprocating parts of machinery. In architecture, the use was largely confined to windows and ornamental applications where good resistance to atmospheric corrosion offers the advantage of lowered maintenance costs.

Interest is being shown in the possibilities of aluminum alloy hopper cars. In this application not only light weight but resistance to corrosion by sulphur-bearing coals are advantages that may justify the higher first cost of aluminum alloy construction. Several experimental cars built a number of years ago have been in operation carrying coal and sulphur. Their performance has justified the expectation of longer life and lowered maintenance costs. Further experience will determine whether the advantage is sufficient from an economic standpoint.

In the prewar passenger automobile, the use of aluminum was limited largely to pistons, where the high thermal conductivity of the metal was an advantage in permitting higher compression ratios. Some use had been made of cylinder heads for the same reason. While it is not expected that the first postwar cars will be greatly different from the last model that was made, automobile companies have become familiar with the use of aluminum alloys in their construction of airplanes and military vehicles, and it will be surprising if succeeding models do not show increasing use of the light alloys, both aluminum and magnesium.

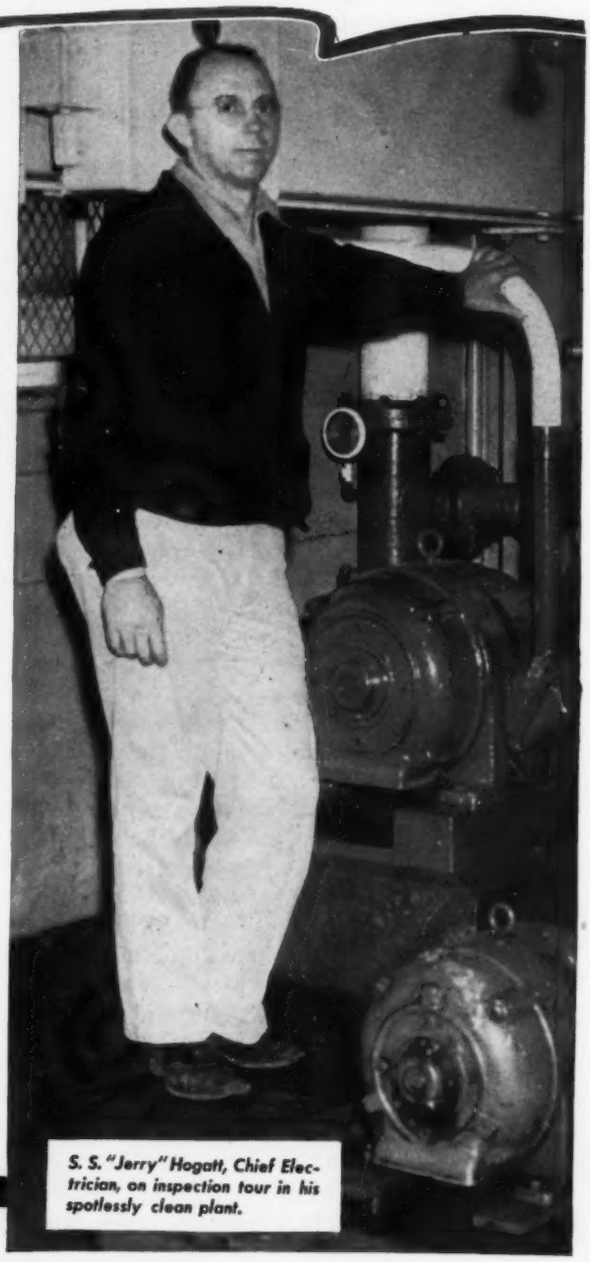
This discussion has not attempted to cover all of the possible uses of aluminum alloys nor to answer all the questions concerning the postwar status of the industry. An attempt has been made to give a resume of the war time developments and to suggest certain uses that may be expected to take up the slack as war demands relax.

"We Put An End To Electrical Shutdowns On Our Compressor Circuits By Standardizing On BUSS Super-Lag Fuses"

—S. S. "Jerry" HOGATT, *Chief Electrician*
JACKSON BREWING CO. • NEW ORLEANS

Bernard L. Kiernan, Chief Engineer, checking operation charts in his office.

Mr. Bernard L. Kiernan, Chief Engineer of Jackson, the largest brewery in the South, amplifies Mr. Hogatt's statement with these added facts—"Our compressors and pumps formerly gave us constant trouble. Frequent fuse blowing, due to the heavy load when the compressors started, caused many shutdowns. We couldn't afford the costly experience of having our equipment out of service when we needed all the production we could get. We eliminated that problem, though, when we standardized on BUSS Super-Lag fuses. They have helped us save a lot of time, annoyance, and expense—and helped keep production up, too."



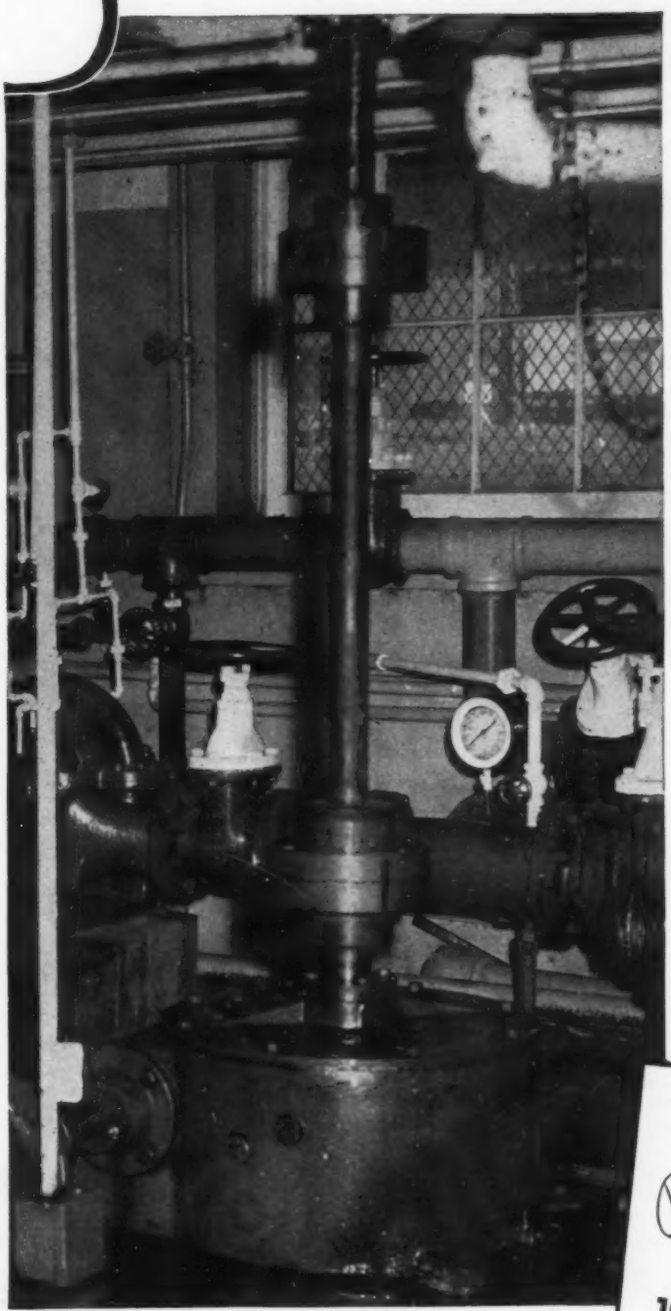
S. S. "Jerry" Hogatt, Chief Electrician, on inspection tour in his spotlessly clean plant.

BUSS *Super-Lag*

SOLD THROUGH WHOLESALERS

Why BUSS Fuses greatly reduce or entirely prevent needless blows

The fuse case is designed to insure good contact on the link, even when the fuse is renewed by an inexperienced person—and it is so designed that vibration or heavy overloads or the constant heating and cooling of the fuse will not permit poor contact to develop. Thus excessive heating, which causes fuses to blow needlessly, is prevented.



The fuse link used is the famous "BUSS Super-Lag". It has lag-plates attached to it. These give it a time-lag so long that it will reduce to an extent not possible with any other renewable fuse, the number of shutdowns caused by needless fuse blows.

Prevent future trouble in your plant—by doing this today

Pass the word along that all purchase records dealing with circuit protective devices should be immediately changed to call for BUSS Super-Lag Renewable fuses. Then, as fuses are replaced or new installations made, your plant will automatically get the benefit of the care-free, trouble-proof protection that BUSS Super-Lag fuses afford.

BUSSMANN MANUFACTURING CO.
St. Louis 7, Mo.
Division McGraw Electric Company

FUSES

Why BUSS Fuses Don't Blow Needlessly

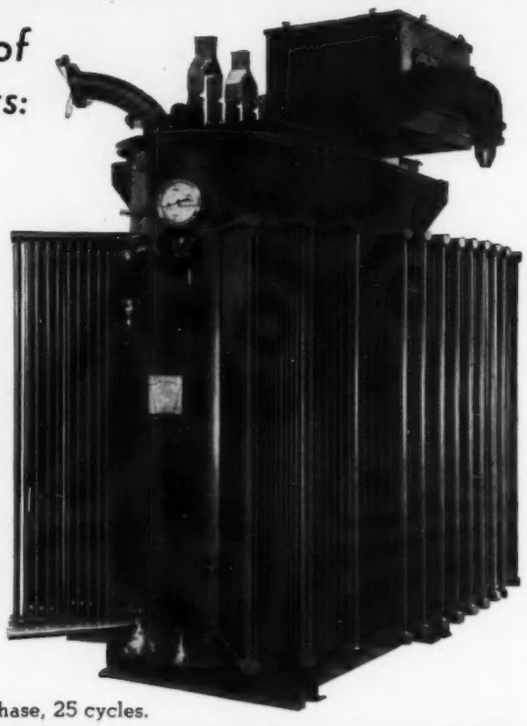
10 FEATURES in the design of the FUSE-CASE help make it possible *and* **The SUPER-LAG** development in the FUSE-LINK completes the job.

For convenience and economy of transformer installations indoors near the load centers

Ask for Askarel

Pennsylvania's noninflammable, non-explosive, liquid-filled transformer

✔ Check these outstanding qualities of Pennsylvania Askarel Transformers:



3000 kva, ASKAREL, 3 phase, 25 cycles.

✔ Circular Coils Possess Maximum Inherent Strength

In regular oil-cooled transformers, varnish is used to increase the mechanical and electrical strength of the transformer coils, irrespective of the shape of the coils. This kind of varnish, however, cannot be used to treat coils in a transformer where noninflammable liquids are employed. Therefore, without the aid of this varnish, it is imperative that the coils in a noninflammable transformer have great inherent strength. Pennsylvania circular coils possess the maximum inherent mechanical and electrical strength!

✔ Radiators Built to Withstand High Pressures

Askarel transformers develop high pressures inside the tank because of the sealed, pressure-tight, tank construction necessary to prevent loss of Askarel through evaporation. Sturdy Uni-Row radiators on Pennsylvania Askarel transformers are designed to meet these high pressures. As rugged as the tanks themselves, these radiators are permanently welded in position and tested at 100 lbs. pressure. Radiators are spaced around the tanks so that each tube of each radiator is easily sandblasted, cleaned and painted.

✔ Self-Reclosing Safety Valve Relieves Excessive Pressures

Safety valves are mounted on the covers of all Askarel transformers above 25 kva, and operate in case abnormal pressures exceeding 12 pounds per square inch develop inside the tanks. These safety valves are self-reclosing to prevent foreign matter from entering the transformers.

333 kva, ASKAREL, 1 phase, 60 cycles.

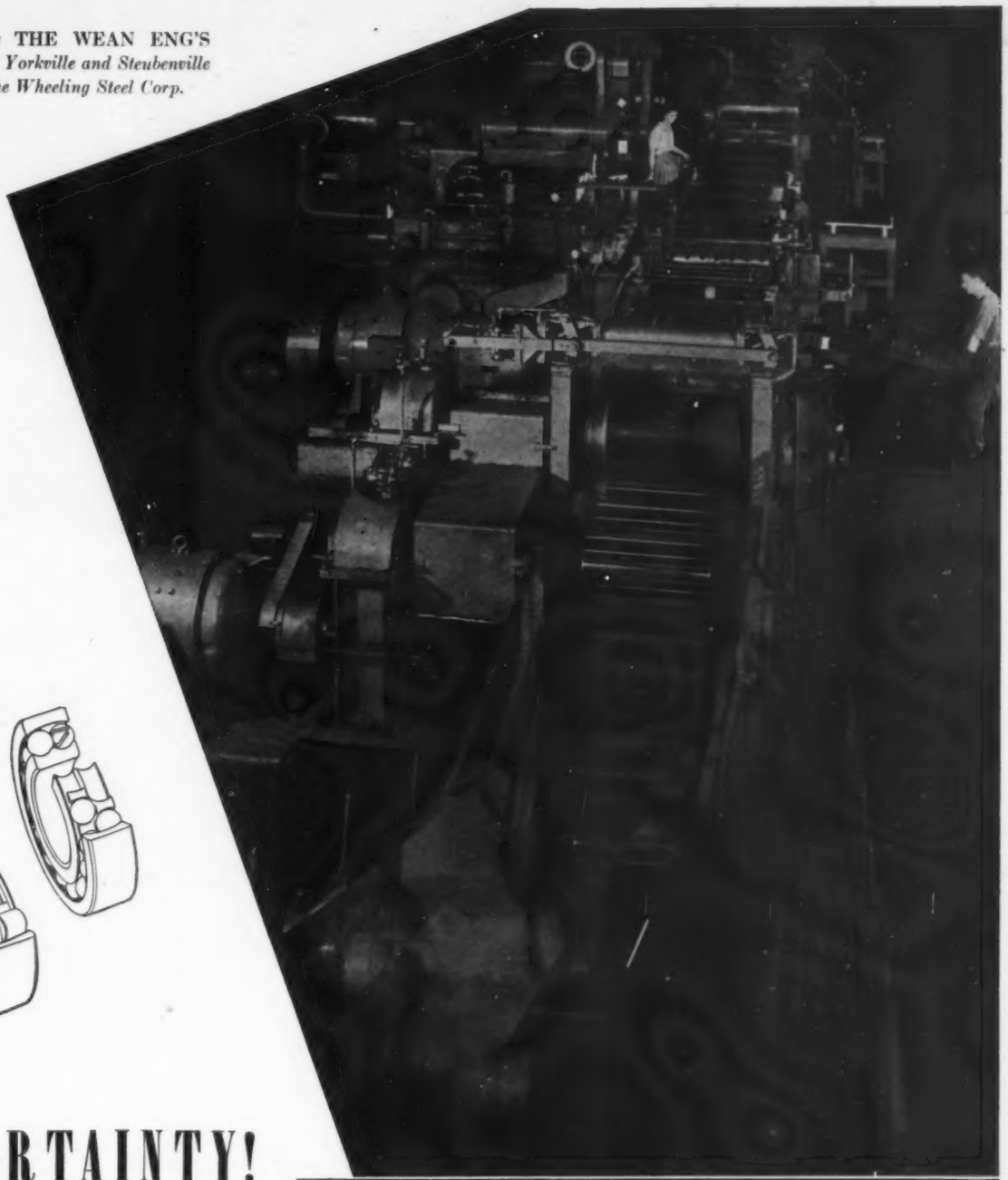
25 kva, ASKAREL, 1 phase, 60 cycles.

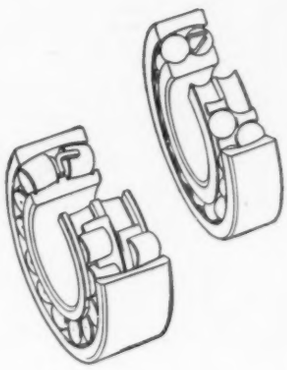
Pennsylvania TRANSFORMER COMPANY
PITTSBURGH, PENNSYLVANIA

Pennsylvania TRANSFORMERS

- Since Askarel Transformers are noninflammable and nonexplosive, they may be installed indoors at the load centers without a vault or fire door.
- Since Askarel is nonsludging and nonoxidizing, and the transformer tanks are pressure-tight and moisture-proof, Askarel transformers may be installed outdoors as well as indoors.

● *Built by* THE WEAN ENG'S CO., *for the Yorkville and Steubenville plants of The Wheeling Steel Corp.*





FOR CERTAINTY!

That moving parts on this Electrolytic Tinning Machine may turn freely, more efficiently, more certainly. That waste in labor and machine tieups resulting from bearing trouble may be curtailed. That production may be increased. These are the reasons why at least 80% of the bearings throughout this machine are SKF's. Every tick of the clock, year in and year out, finds SKF Bearings giving carefree performance, requiring only occasional lubrication, and never needing adjustment. No matter how *small* or BIG the job, SKF puts the right bearing in the right place.

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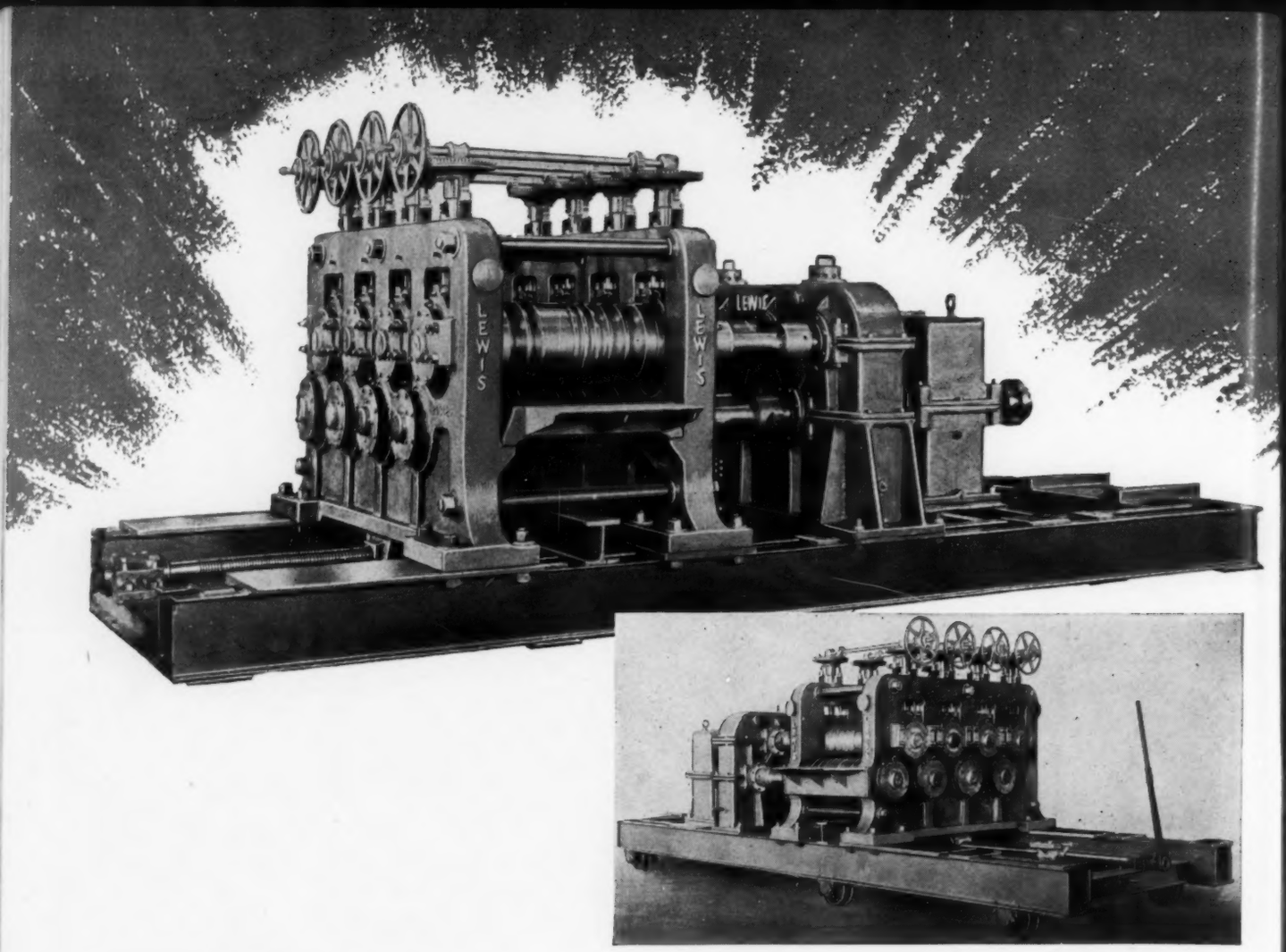
BEARINGS



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Are Helping to Speed the Russian Steamroller

Because Russia wants the best in modern machines and materials her technical experts have called upon Lewis for thousands of tons of Rolling Mill Equipment.

Among recent shipments to the U.S.S.R. are the 18-inch Straightening Machines shown above. One is stationary while the other is a shuttle type which can be moved in and out of the "line" as required. Both have a maximum capacity of 4-inch rounds, and both are of exceedingly rugged and foolproof construction.

ARMY E NAVY

6 plants of Blaw-Knox Company have been awarded the Army-Navy "E" for excellence

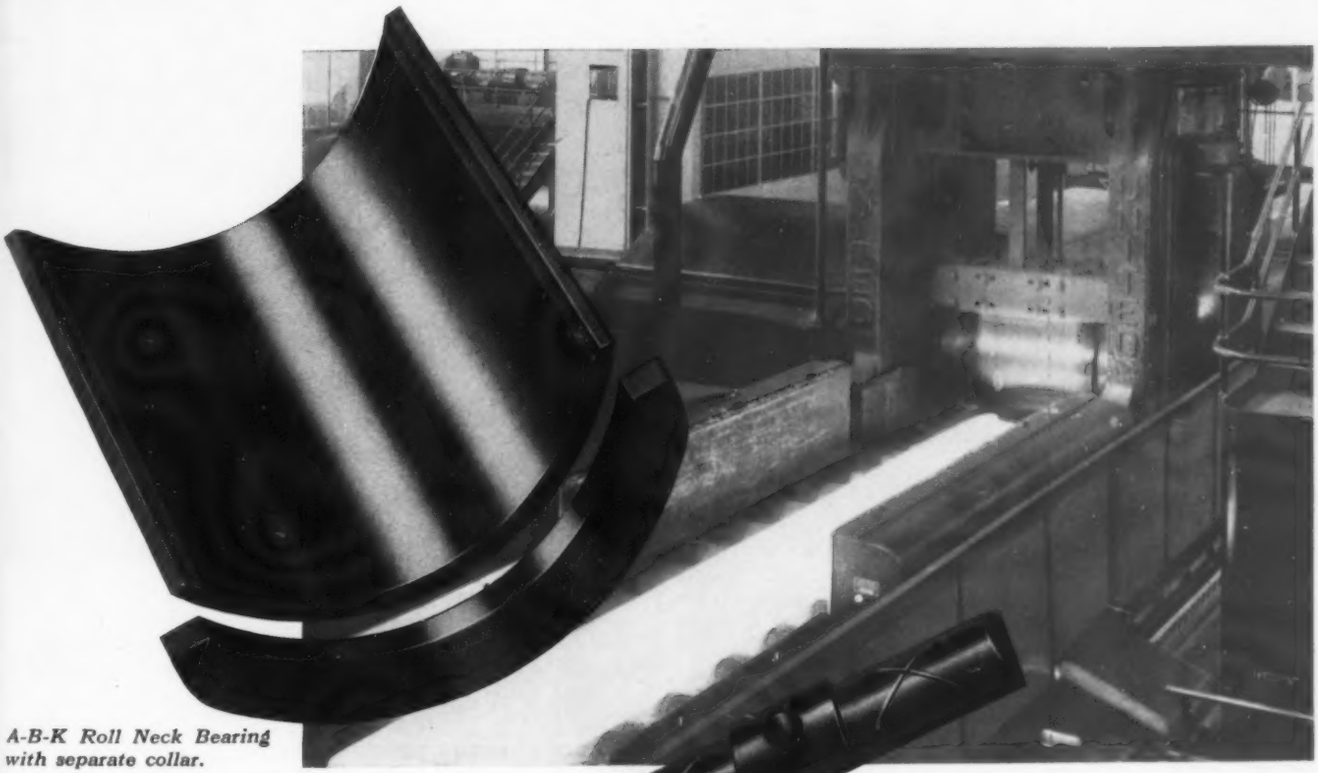
LEWIS FOUNDRY & MACHINE

DIVISION OF BLAW-KNOX COMPANY, PITTSBURGH, PA.

Speed Up Production – Cut Power Consumption

A-B-K

Laminated Plastic Bearings



A-B-K Roll Neck Bearing with separate collar.

A-B-K Patented Reinforced Edge Slipper Bearing made in required sizes to blue prints.

Phantom view of A-B-K Patented Reinforced Edge Slipper Bearing.

PERFORMANCE check-ups on the operation of A-B-K Laminated Plastic Bearings under peak production in steel mills prove conclusively that—

1 More tons of steel are rolled per set of A-B-K roll neck bearings because the rolls do not need adjusting so often, sheets are rolled to closer gage and the bearings last many times longer than metal.

2 Power consumption shows a substantial dividend on kilowatt hours saved.

3 Many costly shut down periods for bearing replacement are avoided.

4 Roll Neck lubrication costs are practically eliminated.

A-B-K Laminated Plastic Bearings were designed by American Brakeblok engineers to fit the difficult problems of steel mill production.

The same research and engineering facilities that provide these dependable bearings are available to you. Phone, write or wire, American Brakeblok Division, 4600 Merritt Avenue, Detroit 9, Michigan.

American Brakeblok

DIVISION OF AMERICAN Brake Shoe COMPANY

Leveller in foreground; welder in action behind.

Former and welder (left) powered by two Type T Heavy-duty Reliance Splash-proof Motors.

• Feeding steel plates through a leveller, then into a welder, next to a former and finally into a pipe straightener is a rough, tough job—yet one which requires fine synchronization and hairline control.

It is being done successfully and profitably by means of Reliance Motor-Drive—a combination of all-electric controls which takes care of each operation in sequence and turns out a highly satisfactory finished product.

It will pay you to investigate the possibilities of handling operations of this kind electrically—the Reliance way. An application engineer will be glad to show you detailed information on the ways in which steel men are making use of Reliance V★S Drive.

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RELIANCE A·C D·C MOTORS

"Motor-Drive is More Than Power"

THIS *built-in "brain"* PRODUCES CORRECT ROLL CURVATURE *automatically*

To take the guesswork out of roll crowning and concaving, Farrel Roll Grinders have a built-in device which automatically produces a mathematically accurate curve for either a crowned or concaved roll, with both halves perfectly symmetrical. The same setting invariably produces exactly the same curvature and permits uniform and easily controlled accuracy of contour in all rolls.

This patented device is of the adjustable, single eccentric type, designed for ease and simplicity of setting and assuring exact synchronism between wheel carriage and wheel.

The built-in "brain" is only one of many features which enable Farrel Roll Grinders to perform with maximum accuracy, speed and efficiency. Other features include: Automatic lubrication of all vital moving parts . . . long-wearing inverted "V" carriage ways . . . smooth headstock drive by adjustable speed motor through multiple "V" belts . . . smooth, vibrationless carriage traverse . . . centralized control of entire grinding operation.

Farrel Roll Grinders are available in two types. Type HD, with traveling wheel and stationary work, is made in six sizes to take maximum roll diameters of 24", 28", 36", 44", 50" and 60"; any length between centers. Type TT, with traveling work and stationary wheel, is made in four sizes, for 20", 24", 28" and 32" maximum diameters, and for any length between centers.

For complete information send for descriptive bulletins.

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Plants: Ansonia, Derby and Stonington, Conn., Buffalo, N. Y.
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Modernize with "Packaged Drive"

Westinghouse GEARMOTORS and Speed Reducers

Save Space
Save Installation Time
Reduce Maintenance
Increase Safety
Improve Appearance

Gearmotors come complete in one "package"...ready for operation

Check up on your motor drives. Reconversion problems put a premium on their efficiency and economy.

Since the widespread use of gearmotors almost twenty years ago, performance records have proved them to be the most economical answer to drives which need speed reduction...and four out of every five drives do need speed reduction.

The efficiency of gearmotors stems from two major savings: (1) reduced power losses...no belts, ropes, and pulleys, etc.; (2) longer life and reduced outage time...maintenances seldom more than oil changes.

It's important, too, that your drives are engineered from one responsible source. When you come to Westinghouse you get undivided responsibility...the motor and gears are built by one manufacturer. Call your Westinghouse office, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa. J-07231

Typical is this belt-conveyor drive requiring 16 parts, and 37.6 square feet of floor space. It had a drive efficiency of 80.9% (with conveyor speed of 30 rpm), and required frequent lubrication of pillow block and gears.

Only a gearmotor and coupling are required, and only 17 square feet of floor space is used...and efficiency is increased to 85.4%. Lubrication system requires attention only twice a year...for oil changes.

Westinghouse

There is a Westinghouse speed reduction unit for most application needs

For Drives of 1 to 75 h p

Three types of Westinghouse Gearmotors—Type A, Type C, Type E furnish gear ratios from 1.22 to 58.3, available with single-phase, polyphase and direct-current motors.

HERE ARE 9 GOOD REASONS WHY YOU SHOULD INSTALL WESTINGHOUSE GEARMOTORS:

1. FEWER PARTS TO WEAR.
2. BPT "TOUGH-HARD" GEARS AND PINIONS.
3. USE ALL WESTINGHOUSE MOTOR TYPES.
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7. IMPROVED FOUNDATION STABILITY.
8. MOTOR AND GEARS BUILT BY ONE MANUFACTURER.
9. DESIGNED AND APPLIED TO A.G.M.A. STANDARDS.

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Here are seven good reasons why you should install

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- Antifriction bearings
- Simple, positive lubrication
- Heat-treated helical gearing
- Liberally proportioned gear cases assure alignment of rotating parts
- Low power loss for high efficiency
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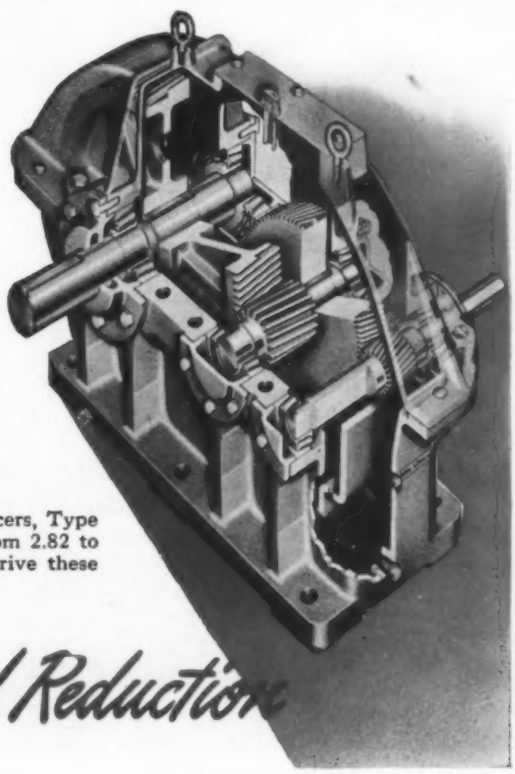

Two major types of Westinghouse Speed Reducers, Type SH and Type DH, offer speed reduction ratios from 2.82 to 70.5. Westinghouse also furnishes the motor to drive these units—for a complete installation.

4 out of 5 drives need Speed Reduction

Dependable Performance

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P-G *Steel Grid Resistors*

In steel mills widespread acceptance of P-G Steel Grid Resistors is the direct result of outstanding records for constant dependable performance. Service records are created by use of durable materials in unique and exclusive design to produce resistors able to easily meet the most exacting requirements. Always specify P-G for continuous Trouble-Free performance.

- ★ ALL STEEL CONSTRUCTION
- ★ MICA INSULATION
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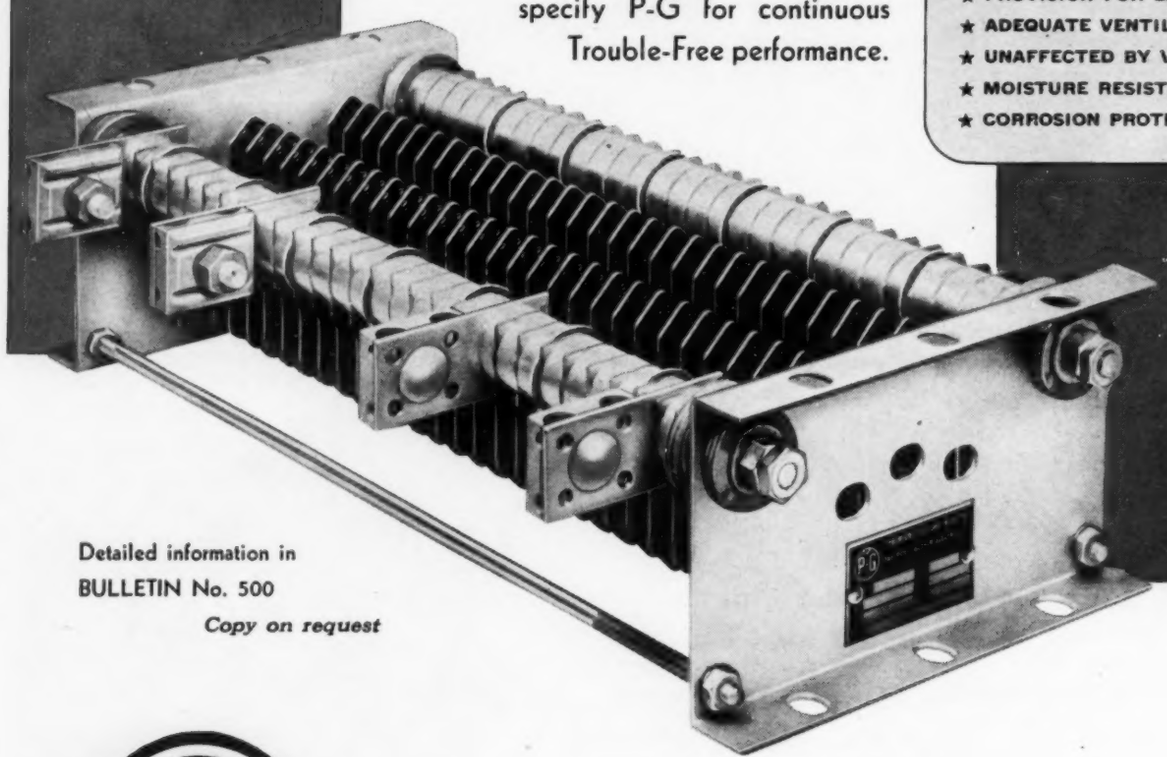

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P-G

The Nonbreakable Steel Grid Resistor

THE POST-GLOVER ELECTRIC COMPANY

• ESTABLISHED 1892 •

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IT'S THE ENGINEERING OF EACH PART THAT GIVES YOU THAT "Extra" in Service

● Top performance in belt conveyors depends, in great measure, on the structure on which the load moves. LINK-BELT Roller Bearing Belt Conveyor Idlers are the outgrowth of almost 50 years of constant development. Engineering that progressed to keep ahead of growing service needs has achieved outstanding design in today's LINK-BELT IDLERS.

You can depend on them, and there is every reason why, to require minimum power and maintenance — to perform smoothly and dependably and to add to the ordinary life of belts.

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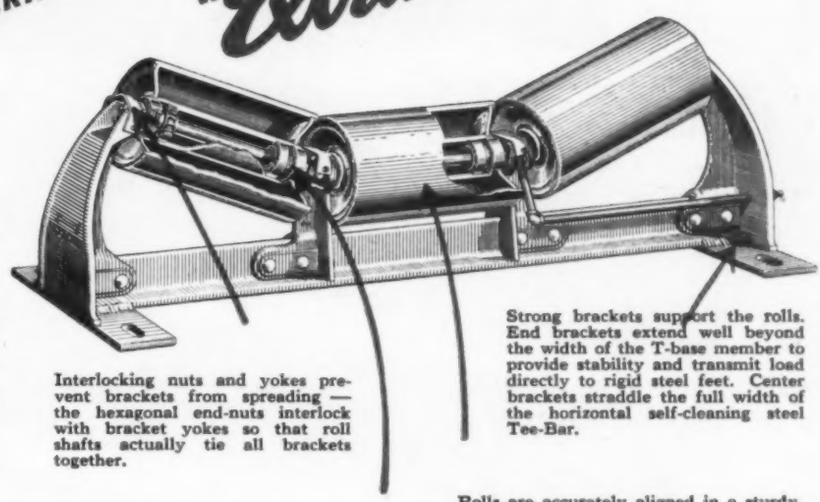

Interlocking nuts and yokes prevent brackets from spreading — the hexagonal end-nuts interlock with bracket yokes so that roll shafts actually tie all brackets together.

Strong brackets support the rolls. End brackets extend well beyond the width of the T-base member to provide stability and transmit load directly to rigid steel feet. Center brackets straddle the full width of the horizontal self-cleaning steel Tee-Bar.

POSITIVE GREASE SEAL keeps grease in and dirt out—conserves lubrication — prolongs bearing life. No springs, no loose parts, no sliding metal-to-metal contact.

Rolls are accurately aligned in a sturdy, streamlined frame assembled in jigs to assure correct bracket spacing and roll interchangeability.

LINK-BELT COMPANY

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Book No. 1915 gives full particulars

This 16-page book is packed with detailed information on LINK-BELT Belt Conveyor Idlers and the various types available in the "100" series. Drawings are shown with tables giving list prices, dimensions in inches, and weights in pounds. Write today for this book.

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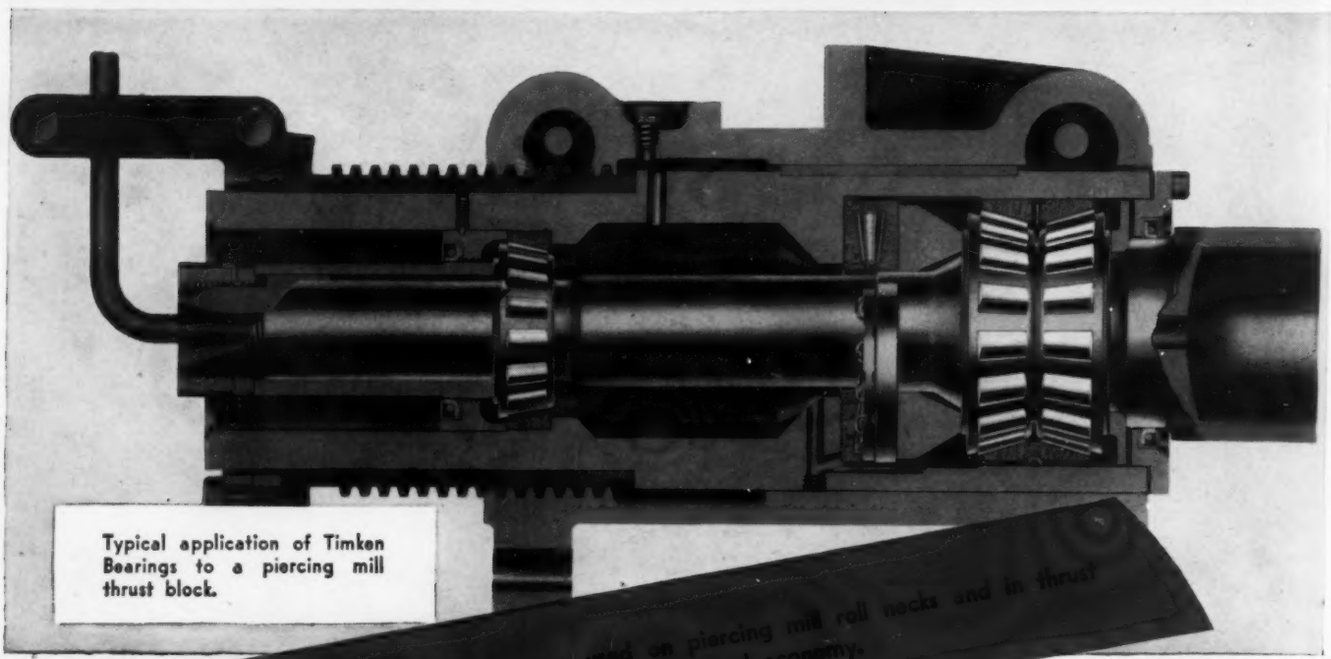
IDLERS • TRIPPERS • BELTS • PULLEYS • BEARINGS • DRIVES

Better Seamless Tubes at *Lower Cost* with *Timken Bearing Equipped* Precision Mills



Typical application of Timken Bearings to a piercing mill thrust block.

Timken Tapered Roller Bearings are used on piercing mill roll necks and in thrust blocks to promote greater accuracy, endurance and economy.

They increase piercing mill efficiency to such an extent that no mill can be called really modern unless it is Timken Bearing Equipped.

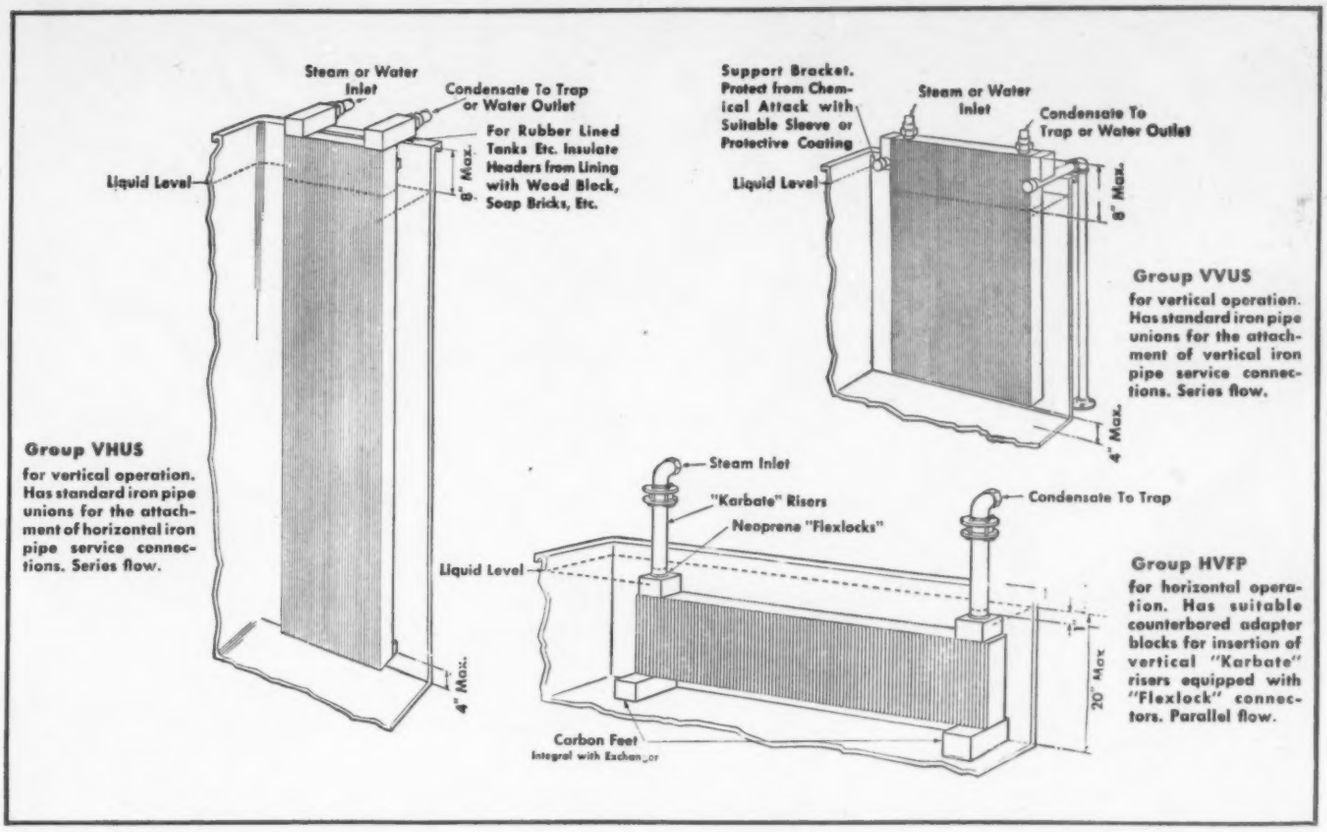
With friction and wear eliminated; radial, thrust and combined loads adequately handled; constant alignment of moving parts assured, operating speeds can be higher —maintenance costs are lower—power consumption is decreased.

When purchasing new seamless tube mills make sure they will be truly modern—now and for many years to come. Specify "Timken Bearing Equipped" and be sure the trade-mark "TIMKEN" is on every bearing. The Timken Roller Bearing Company, Canton 6, Ohio.

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS


Steam or Water Inlet
Condensate To Trap or Water Outlet
For Rubber Lined Tanks Etc. Insulate Headers from Lining with Wood Block, Soap Bricks, Etc.
Liquid Level
8" Max.
Group VHUS
for vertical operation. Has standard iron pipe unions for the attachment of horizontal iron pipe service connections. Series flow.
4" Max.
Support Bracket. Protect from Chemical Attack with Suitable Sleeve or Protective Coating
Steam or Water Inlet
Condensate To Trap or Water Outlet
Liquid Level
8" Max.
Group VVUS
for vertical operation. Has standard iron pipe unions for the attachment of vertical iron pipe service connections. Series flow.
4" Max.
Steam Inlet
"Karbate" Risers
Neoprene "Flexlocks"
Condensate To Trap
Liquid Level
Group HVFP
for horizontal operation. Has suitable counterbored adapter blocks for insertion of vertical "Karbate" risers equipped with "Flexlock" connectors. Parallel flow.
20" Max.
Carbon Feet
Integral with Exchanger

CAN YOU SPECIFY THE REQUIREMENTS FOR A GOOD HEAT EXCHANGER FOR TANKS?

That is, the requirements for a heater or cooler of corrosive liquids in tanks for pickling, etching, plating, cleaning, or other services in the chemical and metal industries.

You'll say:

Resistance to strong corrosive chemicals.
High heat transfer ability.
Strength.
Shock resistance, both mechanical and thermal.
Adaptability to your tanks.
Convenient mountings and connections.

National Carbon has developed a number of standard "Karbate" Plate Heater designs that fully satisfy all of these requirements. These designs, three of which are illustrated above, are simple assemblies of sturdy "Karbate" Plate Heater Units. ("Karbate" material is impervious carbon or graphite.)

Within each unit tubular channels are provided for the heating or cooling medium. On the exterior, corrugations provide maximum surface for heat transfer. Finished assemblies come with various types of mountings and adaptable, easy-to-assemble connections.

For information on "Karbate" Plate Heat Exchangers and "Karbate" Bayonet Heaters, write our nearest Division Office for Catalog Section M-8804.

The word "Karbate" is a registered trade-mark of National Carbon Company, Inc.
"Flexlock" is the registered trade-mark of the Flexlock Corp.

NATIONAL CARBON COMPANY, INC.

Unit of Union Carbide and Carbon Corporation

UCC

General Offices: 30 East 42nd Street, New York 17, N. Y.

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KEEP YOUR EYE ON THE INFANTRY...THE DOUGHBOY DOES IT!

● *Skimming over forests, jungles or open country . . . hurdling mountains, valleys, rivers, our Army Air Forces can lay combat telephone wire (Okonite plants make thousands of miles a month) at speeds up to 110 miles an hour. Using equipment developed by the Signal Corps, two continuous five-mile circuits can be paid out during a single flight of a light "grasshopper" plane.*

but here's where *OUR* speed counts

● At home the 7th War Loan is on . . . one mighty effort instead of the two we had up to this time last year . . . a challenge to all of us in industry to get quickly and solidly behind our local bond drive.

Sure — it's a big job to top our quota. Everything about this war is big including our responsibility to those in uniform. Our fighters are depending on us at home to put our job over. It's the least we can do for them — and the War Bond purchase window is the place where your speed counts most now.

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insulated wires and cables including combat wire

The Okonite Company, Passaic, N. J. • Okonite-Callender Cable Co., Inc., Paterson, N. J. • Hazard Insulated Wire Works Div., Wilkes-Barre, Pa.

4081

A routine test that could wreck the plant **made safe** by **HAGAN CONTROL**

THE BOILER PLANT of one of the country's largest steel plants consists of four 2500 H.P. boilers operating at 450 pounds pressure. Primary fuel is blast furnace gas, with powered coal make-up when gas supplies are inadequate.

Continued feeding in case induced-draft fan motors were out of operation might easily wreck the plant—but once a month, for nine years, the plant engineers *deliberately created this emergency*. They provided a special test switch that opened the circuit to these motors and set up exactly the same situation that would result in case of power failure.

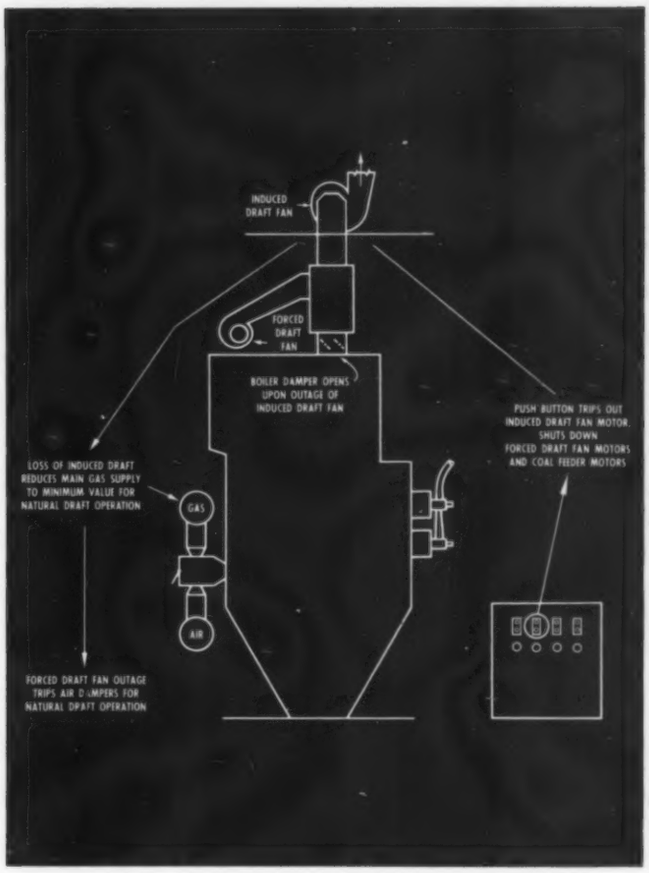
With Hagan Control on the job, here's what happened:

As soon as the induced-draft fans were cut off, the forced-draft fans shut down, the boiler damper opened wide, the feeder motors stopped, air inlets from atmosphere to the gas burners were opened, and the gas control valve closed to a point where it passed only the amount of gas which could be burned with natural draft.

In a matter of seconds, the boiler was automatically and safely adjusted to a reduced rating, with natural draft, until electric power was restored.

This plant has completed 13 years of steady operation, with Hagan Automatic Combustion Control maintaining constant steam pressure in spite of extreme load swings and frequent transitions from one type of fuel to the other.

This great record of dependability is made possible by the Hagan principle that *control and recording are separate functions*. Hagan Control continues to function reliably at ranges well below those at which meter accuracy is guaranteed. Every instrument on the panel can be out of service without affecting the precision and reliability of Hagan Automatic Combustion Control.


INDUCED DRAFT FAN
FORCED DRAFT FAN
BOILER DAMPER OPENS UPON OUTAGE OF INDUCED DRAFT FAN
PUSH BUTTON TRIPS OUT INDUCED DRAFT FAN MOTOR, SHUTS DOWN FORCED DRAFT FAN MOTORS AND COAL FEEDER MOTORS
LOSS OF INDUCED DRAFT REDUCES MAIN GAS SUPPLY TO MINIMUM VALUE FOR NATURAL DRAFT OPERATION
GAS
AIR
FORCED DRAFT FAN OUTAGE TRIPS AIR DAMPERS FOR NATURAL DRAFT OPERATION

Write for full information.

HAGAN HALL BUROMIN CALGON

HAGAN CORPORATION, HAGAN BUILDING, PITTSBURGH 30, PA.

HAGAN *Automatic* COMBUSTION CONTROL

The pioneer . . . and still the leader

"UNIVAN"

That Tough Steel

THEY STAND UP UNDER *SHOCK!* TOO

The head-on smash of these fighting Cape buffaloes ought to result in a couple of cracked skulls. But nature has endowed them with an anatomy that stands up under severe shock, just as advanced metallurgy has made "UNIVAN" the ideal alloy steel for castings which withstand unusual stresses and shock with notable lack of fatigue.

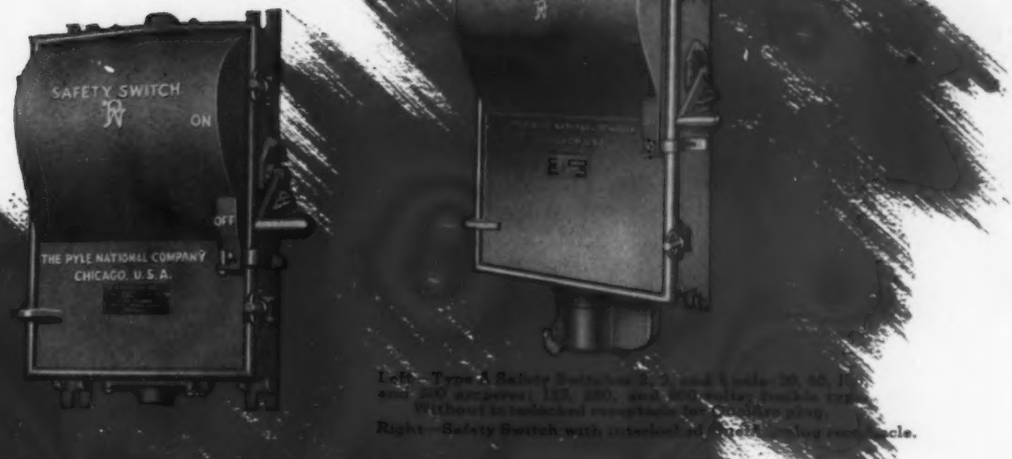
If your castings require these advantages specify "UNIVAN"—*that tough steel*—and take advantage of Union's long experience in whipping the "trouble jobs" of industry.

ARMY E NAVY

UNION STEEL CASTINGS

DIVISION OF BLAW-KNOX CO. PITTSBURGH, PA.

MAKERS OF Driving Wheel Centers, Locomotive Frames, Pump Casings, Vault Doors and Frames, Annealing Boxes, Spindles, Coupling Boxes, Open Hearth Charging Boxes, Gear Blanks — and other Castings for Steel Mills and General Industry.



Left—Type A Safety Switches [illegible] and Right—Safety Switch with [illegible]

Heavy-Duty Safety Switches and Circuit Breaker Pylets

BUILT FOR MILL AND RAILROAD SERVICE

Circuit-breaker Pylet with [illegible] and QuelArc plug.

Pyle-National safety switches have the substantial construction needed to withstand severe operating conditions. The case and cover are heavy-section galvanized cast iron; operating parts are of heavy cast metal, and are designed for quick make and break action. Contacts are mounted on heavy slate. The operating shaft has bronze bearings. The case is fully protected, with both cover and hub plates equipped with weatherproof gaskets. The operating lever extends through the case in a rustproof bearing, and the cover is held closed by rustproof wing nuts and bolts. These features assure dependable service and long life even under severe operating conditions.

Circuit breaker Pylets are of similar heavy duty construction, and are available with or without interlocking receptacle for QuelArc plugs.

Write for Pylet general Catalog 1100 with complete listings.

PYLE-NATIONAL
ELECTRICAL EQUIPMENT
• SINCE 1897 •

THE PYLE-NATIONAL COMPANY
1334-58 North Kostner Avenue
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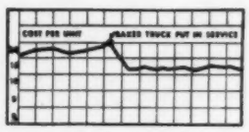
CONDUIT FITTINGS • FLOODLIGHT PROJECTORS

LOCOMOTIVE ELECTRICAL EQUIPMENT

This man can help you gear your plant for post-war

The Baker Material Handling Engineer is at your service to help you meet postwar demands for lower production costs, increased plant capacity and improved working conditions. His intimate knowledge of inside transportation problems—in plant, warehouse, shipping or receiving platforms—enables him to evaluate your complete handling set-up and recommend the proper equipment to achieve objectives listed below, for present or postwar needs.



INCREASED PLANT CAPACITY

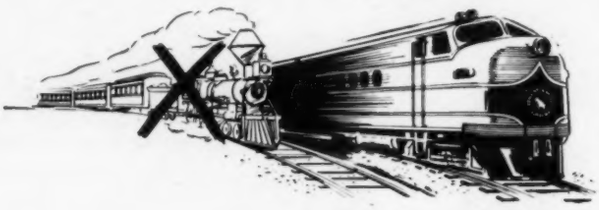
Baker trucks can help you multiply the value of plant floor space by tiering material two or three high (or higher), by storing bulky dies or other material in yards or remote areas, by keeping materials moving and machines running for most efficient production.

GREATER MANPOWER EFFICIENCY

Handling materials faster, handling bigger loads, using one man (or woman) to do the work of 6 or 8 men with hand trucks, getting more out of skilled labor by cutting idle machine time—these are a few of the ways in which Baker Trucks can improve manpower efficiency.

LOWER PRODUCTION COSTS

Since handling of material is not strictly a production operation, it offers one of the best possibilities for savings in overhead cost. Rent costs, machine and labor costs, loading (and unloading) costs, spoilage costs, accident costs—all can be cut by proper use of Baker Trucks.



FASTER DELIVERIES

Streamlining production and movement of material with Baker Trucks can move up delivery dates, shipping and receiving in "unit packages" on skids or pallets means less damage in transit. Faster loading and unloading and better warehouse handling are also important factors.

IMPROVED PLANT SAFETY

Material Handling accidents account for approximately 5 million working days lost annually—about ¼ of the total. Eliminating the handling of heavy objects, overloading hand trucks, improper stacking, and overhead dangers by the use of Baker Trucks, can go far toward reducing this waste.

WRITE FOR YOUR COPY

Plant and production managers, traffic managers, superintendents, purchasing agents and any others concerned with material handling will find the new Baker Catalog No. 52 a valuable reference.

BAKER INDUSTRIAL TRUCK DIVISION *of The Baker-Raulang Company*
2166 West 25th Street • Cleveland, Ohio
In Canada: Railway and Power Engineering Corporation, Ltd.

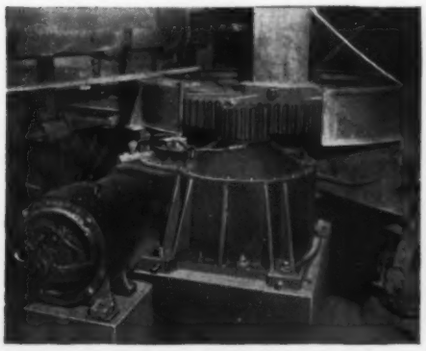
Baker INDUSTRIAL TRUCKS

Jones WORM-HELICAL SPEED REDUCERS

-for Vertical Shaft Drives

THESE machines fill a long felt need for double reduction units of the fully enclosed type to be used for agitators, mixers, ore roasters, bending rolls, etc., requiring a vertical shaft drive. Built in standard ratios in various types of assemblies ranging from 40 to 1 to 250 to 1 for all common motor speeds and a wide range of horsepower ratings.

Jones Bulletin No. 75 covers complete details on these Worm-Helical Speed Reducers, with rating tables, dimension diagrams, torque charts and other application information. We shall be pleased to send you a copy.



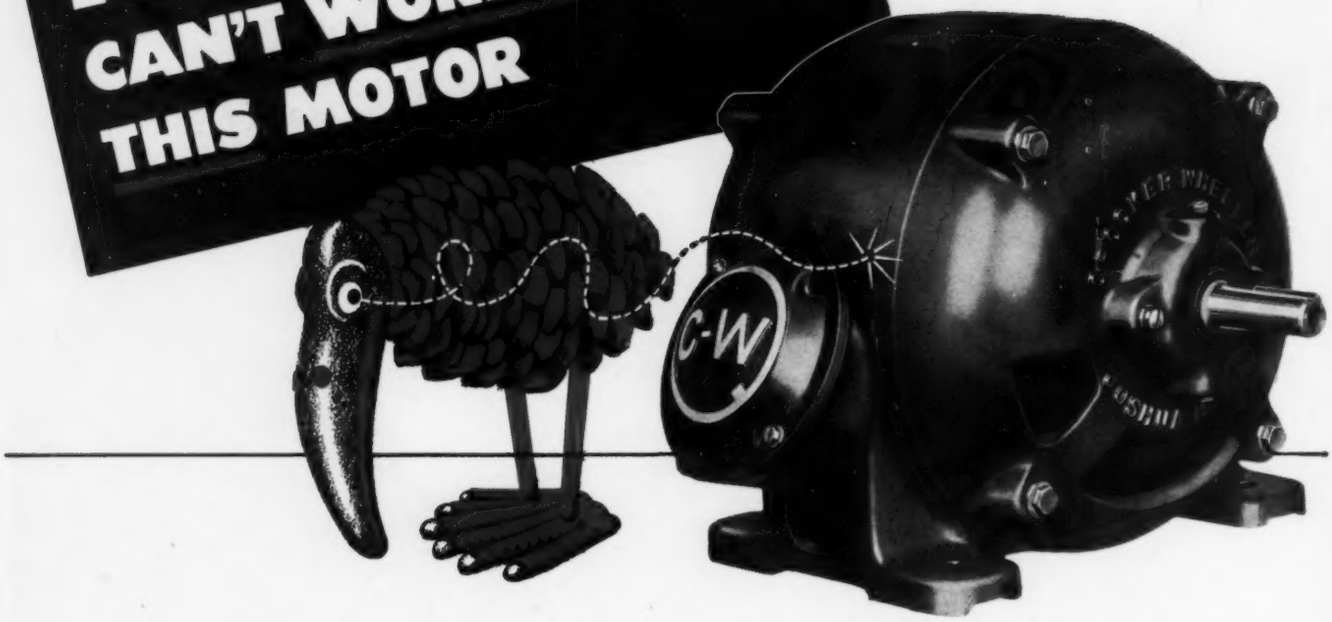
• Jones Worm-Helical Speed Reducer on ore roaster with section of dust guard removed to show final gear reduction.

• Jones Worm-Helical Speed Reducer driving a lacquer agitator. A simple design prevents leakage of oil along the vertical low speed shaft.

• Jones Worm-Helical Speed Reducer on a paper mill agitator drive.

[illegible]

EVEN THE *Worrybird* CAN'T WORRY ABOUT THIS MOTOR



Can't worry about premature breakdown.

The Crocker-Wheeler Protected-Type Motor is built to last. Frame and shields have no openings above the horizontal center line, which means that dripping liquid and falling metal chips won't get in to damage the interior working parts. Vinylastic insulation makes coils dirt, oil, and moisture resistant to a high degree. Phase insulation provides added protection. Dynamically balanced, ALUCAST rotor is practically indestructible.

Can't worry about maintenance.

Patented bearing seal for ball bearings (sleeve bearings are optional) is so effective that re-greasing is required only once a year or even less frequently. This seal permits use of softer grease for better lubrication and longer bearing life.

Can't worry about first cost.

Despite all these advantages, Protected-Type Motors cost no more than conventional open types. They combine added protection with the surplus capacity (40C rise with a 15% service factor) of the open motor.

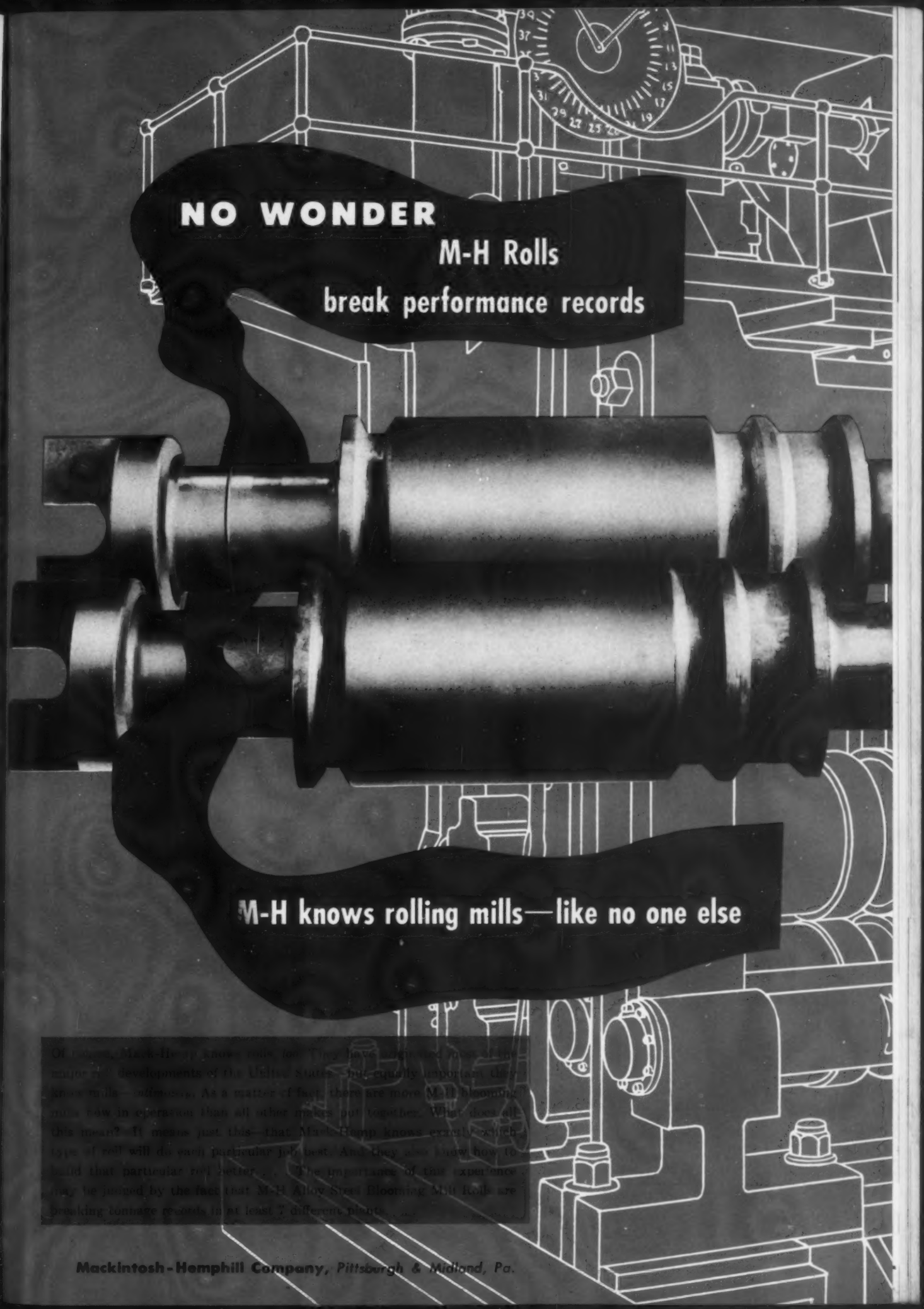
Why not investigate the many advantages of this new motor—to see if you can't end your own worries? Send for your FREE copy of descriptive bulletin, DL-121, that shows how these motors are protected, where they should be used, why they will give long trouble-free service. Write today—no obligation.

CW-1

CROCKER-WHEELER

A DIVISION OF JOSHUA HENDY IRON WORKS, AMPERE, NEW JERSEY

Branch Offices: BOSTON • BUFFALO • CHICAGO • CINCINNATI • CLEVELAND • DETROIT • LOS ANGELES • NEW YORK • PHILADELPHIA • PITTSBURGH • SAN FRANCISCO • WASHINGTON



Of course, Mack-Hemp knows mills, too. They have designed most of the major mill developments of the United States—but equally important they know rolls—differently. As a matter of fact, there are more M-H Blooming mills now in operation than all other makes put together. What does all this mean? It means just this—that Mack-Hemp knows exactly which type of roll will do each particular job best. And they also know how to build that particular roll better. . . . The importance of this experience may be judged by the fact that M-H Alloy Steel Blooming Mill Rolls are breaking tonnage records in at least 7 different plants. . . .

Mackintosh-Hemphill Company, *Pittsburgh & Midland, Pa.*

POOLE

COPY OF CATALOG GIVING FULL DESCRIPTION AND ENGINEERING DATA SENT UPON REQUEST.

FLEXIBLE COUPLINGS

OOLE FOUNDRY & MACHINE COMPANY

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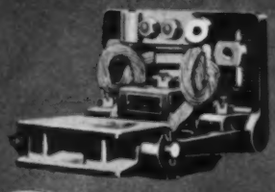
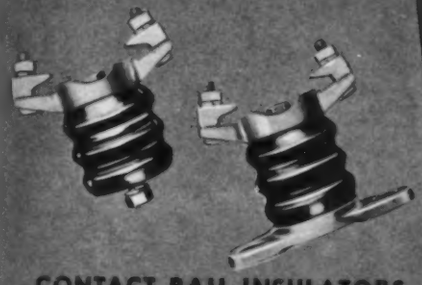
TRAVELING ELECTRICAL CONTACT
AND
HEAVY FEEDER SYSTEM MATERIALS



SHOES AND COLLECTORS



CONTACT RAIL INSULATORS

CATALOG AND PRICES SENT PROMPTLY ON REQUEST

Headquarters

A complete line of contact rail material utilizing either rails, angles or wire as a conductor including numerous types of insulators for either under-running or over-running operation. You may also select from many types of current collectors including Junior, Universal and Pantagraph styles and contact rail shoes.

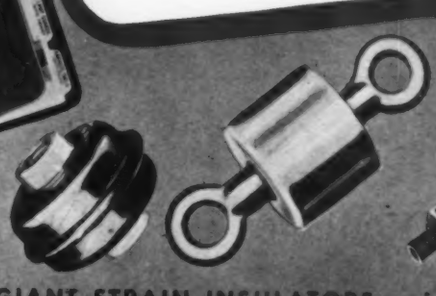
The Keystone line also includes numerous types of clamps and insulators for the insulation, suspension and dead-ending of heavy feeder cables.

These products are widely used in most large steel mills, being thoroughly proved in service. The complete catalog illustrated below will be very helpful to all interested in the construction or maintenance of cranes or feeder systems.

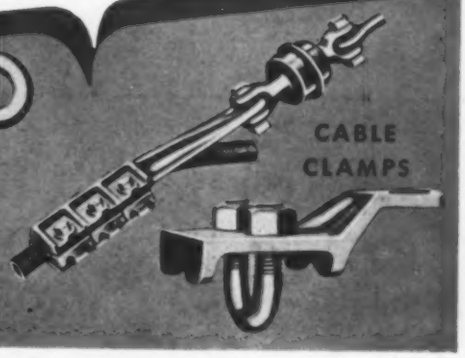
ELECTRIC SERVICE MANUFACTURING CO.

Former Name—Electric Service Supplies Co.

MAIN OFFICE AND PLANT AT 17th AND CAMBRIA STREETS
PHILADELPHIA 32, PA. • BRANCHES IN PRINCIPAL CITIES



GIANT STRAIN INSULATORS



CABLE CLAMPS

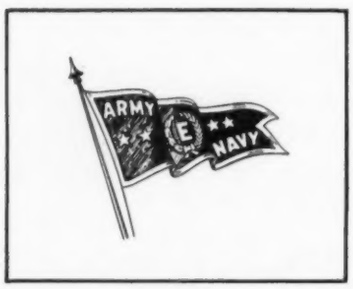
New Proven Method

FOR
CONTINUOUS
PICKLING OF
STRIP STEEL
IN COILS

▼

FAST
ECONOMICAL
SPACE SAVING

▼



Sole Licensee

THE ARMS-FRANKLIN CORPORATION

Engineers and Builders of Rolling Mill Machinery

YOUNGSTOWN 3, OHIO

NEWS SUPPLEMENT June, 1945

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Iron AND Steel ENGINEER

ENGINEERING SERVICE TO THE IRON AND STEEL INDUSTRY SINCE 1907

HOT PATCHING OF OPEN HEARTH FURNACES

By EDWIN N. HOWER, General Masonry Foreman
Carnegie-Illinois Steel Corporation, Homestead, Pennsylvania

Condensation of paper presented before Open Hearth Meeting of American Institute of Mining and Metallurgical Engineers, held in Pittsburgh, Pennsylvania, May 18, 1945.

▲ The cost of hot work plays an important part in the over-all cost of operation in an open hearth shop. Labor and material cost may range from $0.05 to $0.25 per ton of steel produced. Hot work time, depending upon the individual shop condition, will generally range from 4 to 15 min per heat and represent from ½ per cent to 2 per cent of actual operating time. Shops which are operating near the top of these ranges may have an excellent opportunity to effect worthwhile savings by a careful analysis of their hot patching practices.

Good working scaffolds are helpful in speeding up repair jobs and contribute to better workmanship. Prefabricated semi-permanent scaffolds which can be placed on the furnace by the cranes are well worth the trouble involved in storing them when not in use and the extra expense of fabricating them. Prestocking the job is generally advantageous and the use of mechanical equipment will often aid in speeding up the job and keeping costs down. Slight alterations in furnace design and construction will frequently return dividends in the speed and cost of hot repairs. Unless the skew angle is four or five degrees less than the radial angle when installed, the bricklayers will have trouble when it becomes necessary to patch.

On furnaces where end wall repairs are rather frequent and of large extent, the use of a water-cooled box at or near floor level will speed repairs and generally save making awkward, costly patches below floor level.

There are three main classifications of roof patches: (1) Saddle center patches in which a few rings are knocked out and replaced one by one with the center being moved for each ring. (2) Sheet-iron patches in which thin sheets, generally corrugated iron, are bent to conform with the arc of the roof and supported just beneath the inside of the roof when replacing a comparatively large section at one time. (3) Special brick patches.

The saddle center method is probably the most versatile, and in the majority of small jobs the fastest. On furnaces having narrow roofs with small radii and those having pronounced slopes at the necks it is quite adaptable. The sheet-iron center method is widely used on large furnaces and is most effective for large patches. The time required to place the center for a large patch is but little more than for a small one. Special brick shapes may be used independently for patching or in conjunction with either of the other methods. The economy of special shapes is generally doubtful but in certain instances their use can be justified. Patches should always be so constructed as to maintain proper roof contour and avoid buckling (Figure 1).

Refractory guns are meeting with general approval and are helping to eliminate or reduce many large brick jobs. They are especially useful for placing material along the top of the backwall to protect the skewbacks, and in some cases to place material at the top of front wall piers. They are effective for placing refractory material in a hot furnace with a minimum of lost time and seem likely to become an important factor in the reduction of furnace repair costs.

Cost per ton is the deciding factor in determining the length of a furnace campaign, so the cost figures shown in Figure 2 are cumulative for the entire length of run. The furnace is assumed to share in the shop over-

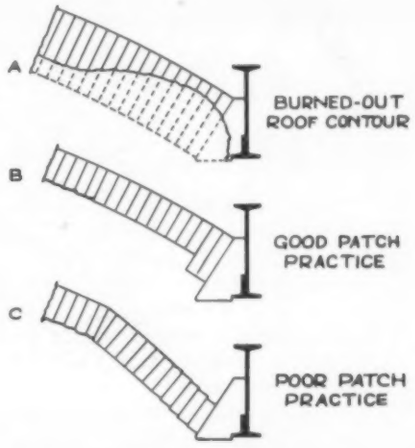
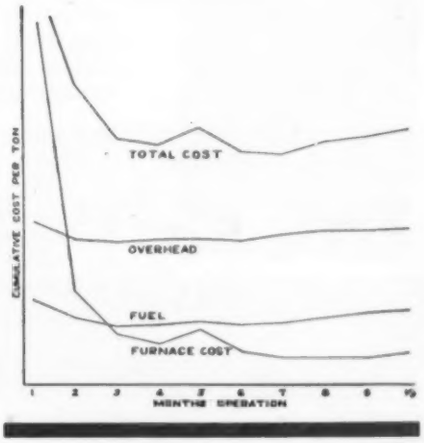


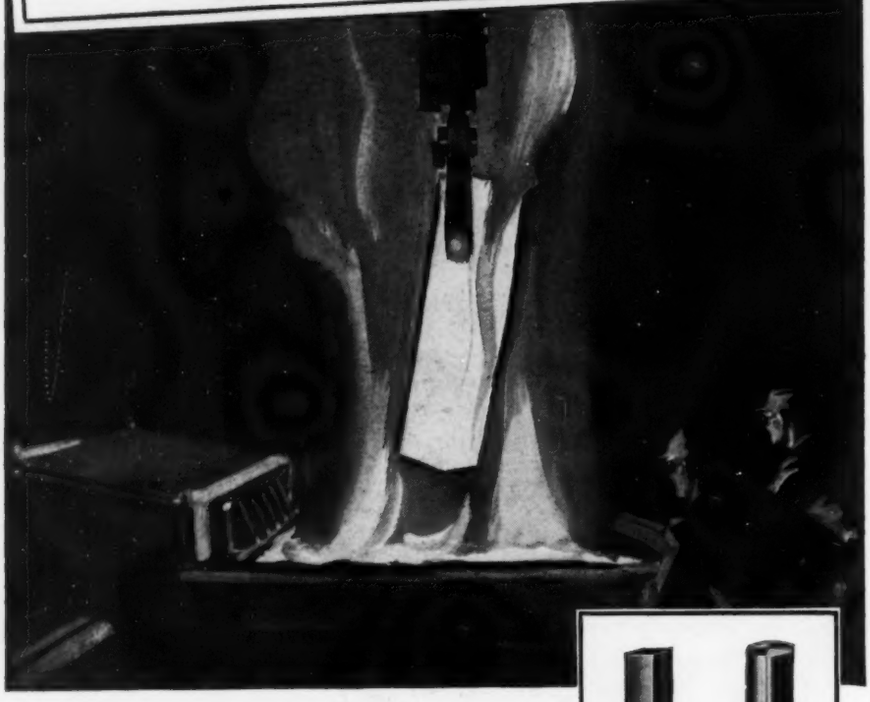
Figure 1 — Patches should be constructed so as to maintain proper roof contour and avoid buckling.

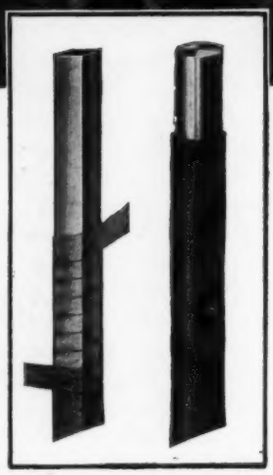
▲

Figure 2 — Curves indicating cost per ton during successive months of furnace operation.



For Permanent PROTECTION Against High Heat





REWIRE WITH DELTABESTON

Provide permanent protection in your plant by rewiring electrical equipment with Deltabeston Magnet Wire. Countless installations have proved that there's no better way to safeguard motors against high ambient temperatures and overload heat than rewiring with Deltabeston Asbestos-insulated and Deltaglass Magnet Wires. These wires are ideal for steel mills because the impregnated asbestos or varnished glass yarn insulation won't bake out in the hot operating conditions encountered in soaking pits, boiler rooms, furnaces and in other torrid zones. Both Deltabeston and Deltaglass are available in round, square and rectangular shapes covering a complete range of sizes.

TYPICAL USES FOR DELTABESTON AND DELTAGLASS MAGNET WIRES

ARMATURES
FIELD COILS
STATOR WINDINGS
MAGNETIC BRAKES
WELDING EQUIPMENT
LIFTING MAGNETS
INDUSTRIAL CONTROLS
SOLENOIDS

Do you have a magnet wiring problem where heat is essential? This catalog will help you. It's free! Write to Section Y653-31, Appliance and Merchandise Dept., General Electric Company, Bridgeport, Conn. All Deltabeston Wires and Cables are distributed nationally by Graybar Electric Company, G-E Supply Corp., and other G-E Merchandise Distributors.

GENERAL ELECTRIC

head in inverse proportion to its tonnage output as compared with the average shop tonnage. During the theoretical campaign illustrated the overhead was high at first due to slow time of heat when starting the furnace, decreased gradually to the middle of the campaign, and then rose as the furnace began to slow up because of leakage and clogging in the pockets and checkers. Fuel costs follow a similar pattern since they are closely related to tonnage output. The furnace cost curve, which is the cost of the rebuild plus the cost of hot patching, is more irregular than overhead and fuel. For the first month or two furnace cost was quite high since the cost of the rebuild was shared by only a comparatively small tonnage. In the third and fourth months it began to level out near its final value. The sharp increase in furnace cost in the fifth month was caused by a large repair job. The continued reduction in furnace cost during the sixth and seventh months justified the cost of this job. Furnace cost continued low for two more months and finally rose during the last month because of the necessity for heavy patching. An examination of the total cost shows that the economic time to have taken this furnace off for rebuild was at the end of seven months, as the increase in fuel and overhead overbalanced the small reduction in furnace cost after this time and after the seventh month the total cost was increased for every ton of steel made since the campaign began. These curves do not cover all factors which must be considered in the operation of an open hearth furnace, but they do give an indication as to the proper length of campaign and the effects of hot patching on furnace costs.

ANTHRACITE IN COAL MIX FOR COKING

▲ As a contribution toward relieving the wartime shortage of certain special coals and to produce enough coke to keep steel furnaces operating at capacity, several by-product coke plants now are mixing fine anthracite with bituminous coal to manufacture coke, and several other plants are conducting experiments in this field.

Nine of the plants surveyed are using anthracite "fines" in regular plant operations to produce blast furnace coke and foundry coke. At seven

other plants, only ovenscale tests had been made, some tests indicating that more extensive investigations were justified and others being inconclusive. At another plant, full-scale tests proved satisfactory. At the remaining four plants it was found that anthracite would be detrimental to their operations.

Results obtained so far in substituting anthracite for bituminous in producing coke are encouraging and it has been recommended that the practice and the tests be continued. It is apparent, however, that the use of anthracite fines is an individual plant problem to be worked out with due regard for the variance in conditions and types of coal — both anthracite and bituminous.

The shortage of low-volatile coking coal and a surplus of anthracite fines are factors favorable to the manufacture of by-product coke of this type. Replacing 3 to 5 per cent of coal with the same proportion of anthracite fines in the coal mixtures used will alleviate both of these conditions.

Detailed reports of the tests and operations at the 21 plants, together with graphs and charts, are given in Report of Investigations 3808, "Utilization of Anthracite Fines in the Manufacture of By-Product Coke," by William Seymour and L. D. Schmidt, which may be obtained from the Bureau of Mines, Department of the Interior, Washington 25, D. C.

TORCH TIPS RECLAIMED BY CHEMICAL TREATMENT

▲ A simple chemical method for reclaiming burner tips and welding torch fittings without manual labor is announced by Turco Products, Inc., of Los Angeles.

Burner tips and fittings used on welding torches and for brazing and burning choke up with tenacious carbon, causing dimensional changes which reduce the efficiency of the equipment. Manual methods of cleaning consume large amounts of time, and rarely is the equipment restored to its original state of efficiency. For lack of an effective method of cleaning, burner tips and fittings have frequently been discarded. To solve this problem, a simple, two-stage chemical process was developed, which makes possible the salvaging of hundreds of these parts.

Burner tips and fittings are first soaked in Turco L-780, a liquid material with solvent and penetrating actions, which digests carbon and gum deposits, softening and loosening them so that they are freely rinsed away. The material is non-corrosive to copper and brass. An overnight soak is sufficient to loosen and soften all carbon and dirt. At the completion of the soaking period, the parts are rinsed clean in a vigorous air and water spray.

After the Turco L-780 treatment, the parts will be physically clean, but will be more or less heavily oxidized and tarnished because of the high heat to which this equipment is exposed. A brief dip in Turco Brass Dip, a safe detarnishing liquid, completely removes this film, leaving the metal completely clean and bright. Turco Brass Dip is used in a ceramic crock or container. Long-lived and active, a small amount of the material will clean several hundred burner tips and fittings.

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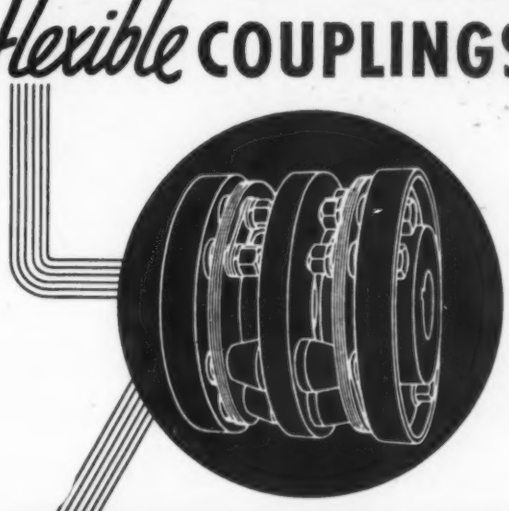
Flexible COUPLINGS



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the four destructive evils of other types and makes of couplings that prevent a permanent care-free installation.

The Thomas All-Metal Coupling has:
No Chains, No Gears, No Rubber.
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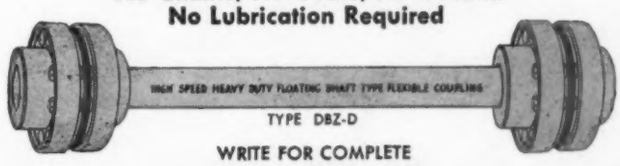

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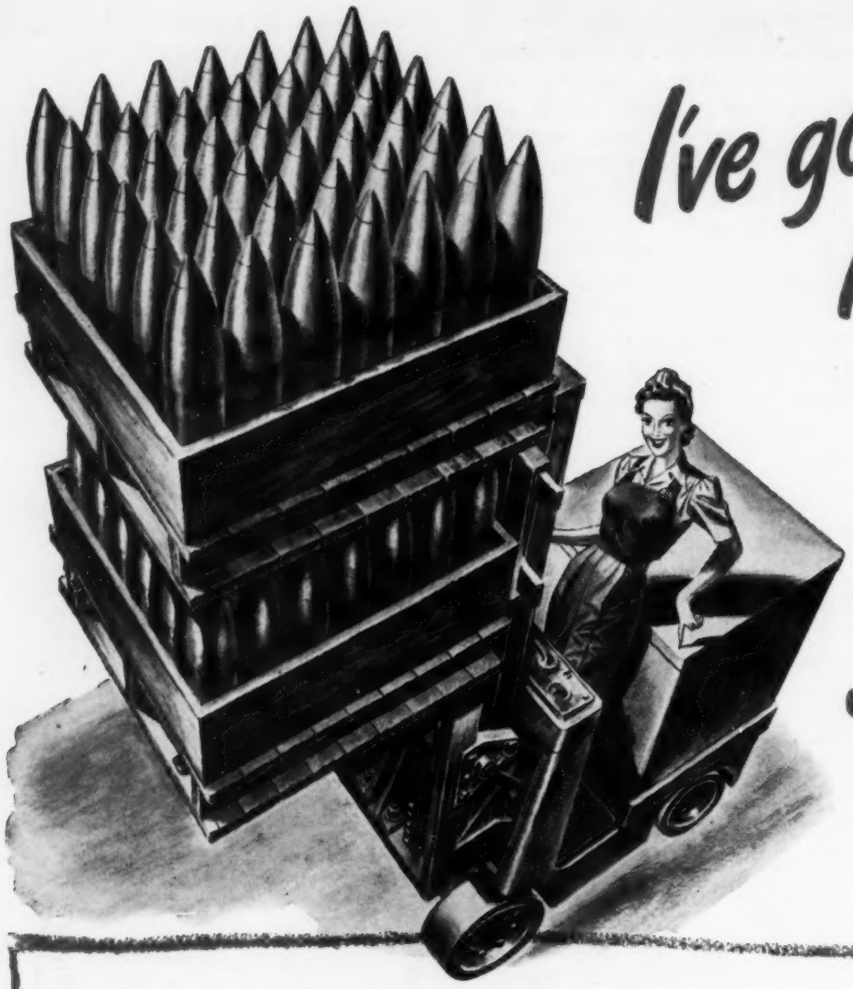

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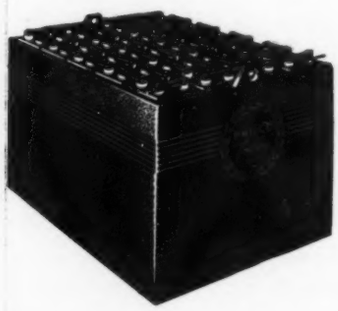
a Philco "Thirty"— the Electric Truck Battery with

30% Longer Life!

FOR 50 YEARS PHILCO HAS BEEN A LEADER IN INDUSTRIAL BATTERY ENGINEERING

To operators of electric industrial trucks a PHILCO has long meant a big storage battery that provides the power to move great pallet loads of materials. For more than 50 years, important developments in storage battery design have come from Philco engineers. The latest of these is this revolutionary new Philco "Thirty", with 30% longer life! It's the toughest battery ever built for heavy industrial motive power service. Its far longer life is news of the utmost importance for all who seek lower costs in materials handling, today and after the war. There's a Philco Storage Battery for every need in industry—mine haulage, railway service, oil switch control, telephone service, and many others. Write for latest catalogs.



In the new Philco "Thirty" Storage Battery, a revolutionary new construction principle employing fabricated glass tape insulation, greatly increases the life of the power-producing positive plates. Only Philco "Thirty" has this great new development which adds 30% and MORE to Storage Battery life.

FOR THE LATEST IN MODERN BATTERY DESIGN . . . SPECIFY

PHILCO *Storage Batteries*

PHILCO CORPORATION • STORAGE BATTERY DIVISION • TRENTON 7, NEW JERSEY

OIL MIST, WELDING FUMES COLLECTED BY NEW UNIT

▲ Recently introduced by the American Air Filter Company, Inc., Louisville, Kentucky, into their electronic line of air filtration equipment is the Electro-Mist, a self-contained, completely demountable electronic unit designed to collect oil mist from high speed cutting tools or welding fumes in light concentrations.

An axial-flow fan mounted on top of the unit draws air from the operation which is properly hooded through piping or flexible tubing into the base of the unit In its application to cutting operations, the mist-laden air first passes through a permanent unit filter to remove any metallic dust or large drops of oil, then enters the ionizer in which the mist and smoke particles receive an electrical charge before passing into the collector unit where they are precipitated on the plates. The collected oil mist accumulates and drips off the lower edge of the plates, through the filter and into a reservoir below. As much as 2 or 3 gallons of oil can be salvaged and may be piped back into the machine tool or drained off as preferred.

The Electro-Mist is made in one size — 28¾ in. x 20¾ in. x 70 in. high. The power pack operates from nominal 115 volts, 60 cycle single phase. On multiple installations one large power pack will handle as many as 10 Electro-Mist collectors.

LINK JOINT TRANSMITS MOTION AROUND CORNERS

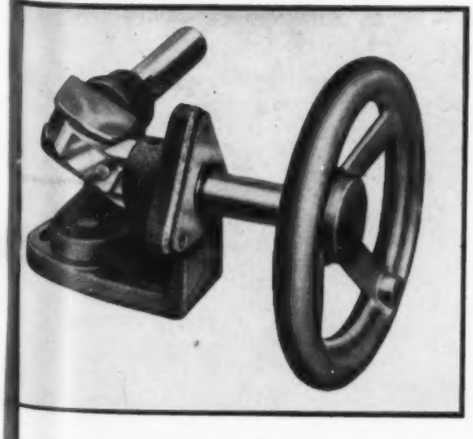
▲ The Piezo universal link joint, manufactured by Piezoelectric Corporation, is a new remote control product featuring an adjustable link mechanism to transmit rotary motion around corners, permitting the operation of shafts at angles adjustables from a straight line (0 degrees) to a right angle (90 degrees). With the use of solid shafting and the absence of flexing or backlash, this makes an ideal method for accurate remote controls, and the simplicity of installation makes it preferable to bevel gears, racks, toggles and other mechanical equipment usually employed for this purpose.

An important feature of this joint is the fact that the output shaft turns in the exact angular rotation as the input shaft, giving an input turning angle equivalent to the output turning angle. This is of particular importance in dial settings and where uniform motion is desired.

The joint is mounted by means of three screws which hold it in position. The bearing arm which holds the adjustable shaft may be hinged to any desired position from 0 to 90 degrees and, when in its proper location, is held permanently in position by a locking screw.

Recommended for hand operation and slow speed power drives, such as those used in the control of electrical switchboards, radios, automatic machinery, valve operation and many other mechanical devices.

Shafts may be operated at any desired angle from 0 to 90 degrees by means of this universal link joint.



LARGE STRESS RELIEF FURNACE FOR NAVY

▲ The Navy Department has awarded Rust Furnace Company, Pittsburgh, Pennsylvania, a contract for a stress relieving furnace equal in size to the largest ever built, which was also recently designed by Rust for naval use. The new furnace will have the additional characteristic of being a movable unit, capable of ready disassembly and reerection in different locations.

Destined for Hunters Point, California, for stress relieving the heaviest battleship turrets, the big stress reliever will be 48 ft wide by 56 ft long by 30 ft high. It will be indirect-fired with forced recirculation of hot gases, being equipped with two outside independent combustion chambers and two recirculating units.

Contract for another stress relieving furnace for Hunters Point, direct-fired car-type, has also been awarded Rust by the Navy. The two contracts total somewhat less than $200,000.

LUBRIPLATE No. 105

This very smooth, light density (semi-fluid) grease type lubricant resists water and other unfavorable operating conditions to a marked degree. LUBRIPLATE No. 105 not only provides superior lubrication but offers utmost protection against rust and corrosion. Because of its waterproof feature and freedom from "drag", it is ideal for

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Lubricants are extremely economical for reason that they possess very long life and "stay-put" properties. A little LUBRIPLATE goes a long way.

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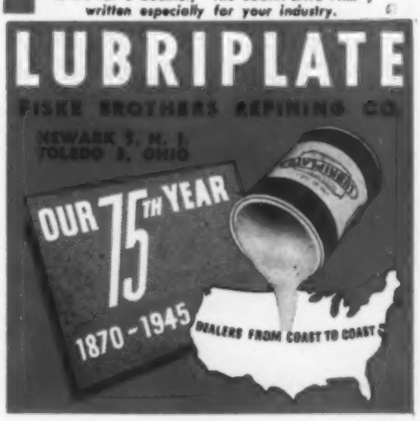
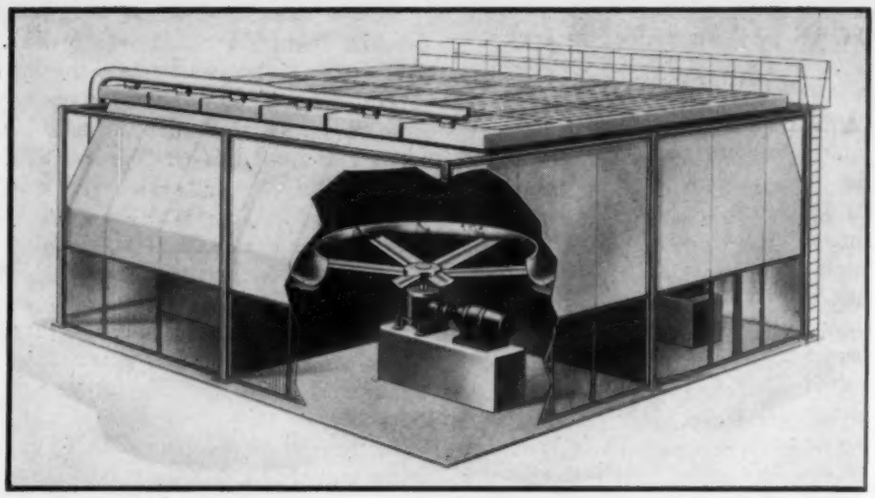


FORCED DRAFT UNIT

COOLS LIQUIDS, GASES

▲ The Fin Fan cooling unit manufactured by The Fluor Corporation, Ltd., Los Angeles, Cal., is composed of cooling sections employing the highly efficient K-fin tube construction and cooled by forced draft fed by air from the cooler layer at ground level and supplied by fans with variable pitch blades and with variable speed drive. Vertical air flow against static head assures even air distribution over cooling surfaces. Fin Fan units are designed for pressures to 5000 psi and temperatures to 1500 F, and have been applied in cooling liquids and gases and in condensing steam, still vapors, etc. Coils are located to provide sufficient static head for pump suction. Tubes can be removed and replaced quickly and all mechanical equipment is readily accessible from the ground. The Fin Fan unit embodies the combined experience and engineering skill of The Griscom-Russell Company and The Fluor Corporation.



Forced draft, air cooled units of this type have been applied to the cooling of gases and liquids and in condensing steam, still vapors, etc.

COMPARATOR CHECKS PRODUCTION FINISHES

▲ Widespread use of Faxfilm in industry and research where it has been used for checking machined finishes, metallurgical specimens, paper and fabric structure, biological specimens, etc., has indicated the need for apparatus where two surfaces could be compared at 100 diameter magnifications by Faxfilm. This has been provided by the Faxfilm comparator apparatus, model C-1000.

Faxfilm is the method by which an exact replica of a surface is made in clear plastic in less than a minute's time. Projected at 100 diameter magnification, every minute detail of surface conditions of both standard and production check finish is shown.

The comparator apparatus is a complete projection booth containing twin micro-projectors. Use of two first-surface reflectors permits projection of two Faxfilm slides at full 100 diameter magnifications, the images (each 20 in. square) appearing side by side on an inspection table about six inches away from the projectors. This feature permits fine adjustments in focus while standing at the inspection table.

Faxfilms of production finishes may be projected in the comparator beside Faxfilm standards for easy and accurate inspection and comparison. The holders for the Faxfilm slides are movable so that the direction of machine markings in each image can be matched and any part of one image can be made to appear beside any part of the other. The comparator apparatus requires about the same floor space as an average desk and may be set up in almost any part of plant or office. Use of the comparator in receiving departments, for example, would permit quick inspection of finishes on incoming materials before they were distributed or stored. Placed along production lines it would give immediate information concerning finishes obtained and the condition of cutting tools or grinding equipment.

Mark HOT Metals with MARKAL PAINTSTIKS

CAN BE MARKED AT TEMPERATURES as low as 150°F as high as 1800°F

Marks Won't Run, Fade, Smear or Burn Off

MARKAL PAINTSTIKS are the recognized "MUST" in more and more plants requiring the permanent marking of hot metals. They're positive, weather-proof, fade-proof, easy to use, always ready for instant use. Can be applied under blinding heat. After cooling, marks will not peel, crack or discolor. Marks are removed in pickling bath.

1600° F. Ingot being marked with MARKAL PAINTSTIK at Inland Steel Co.

MARKAL PAINTSTIKS also made for all Cold Surface Markings

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"Originators of Paint Sticks"

FORK TRUCKS HANDLE VARIETY OF PRODUCTS

▲ Handling large carboys of acids and cylindrical packages of chemicals in lump or powder form under wartime conditions has challenged the ingenuity of manufacturers. Production of chemicals has mounted tremendously, requiring a proportionate increase in handling capacity, at the same time that manpower has diminished. It has been necessary, also, to store large quantities by utilizing overhead space.

Hazards that are inherent in this work when done manually have been avoided; a critical manpower shortage has been averted; and costs have been reduced by the use of Elwell-Parker electric fork-type lift trucks.

These have enabled manufacturers to make the fullest use of the pallet system for rapid handling and, where necessary, for high tiering in warehouses.

Four carboys in wood cases, with a total weight of nearly a half ton, are easily handled in one load. To protect the necks of the carboys and afford a support for pallets above floor level, use is made of wood frames, as illustrated.

Dry chemicals in fibre, plastic or wood containers weighing up to one ton or more also are handled by means of pallets and Elwell-Parker fork-type trucks.

WELDING ELECTRODE FOR HIGH-TENSILE STEEL

▲ A new heavily covered arc-welding electrode for welding low-alloy, high-tensile steels has been announced by the Electric Welding Division of the General Electric Company. Specially designed for use on carbon-molybdenum steel in the high-pressure piping industry, this electrode may also be applied to vessels (fittings) and structural weldments of innumerable kinds.

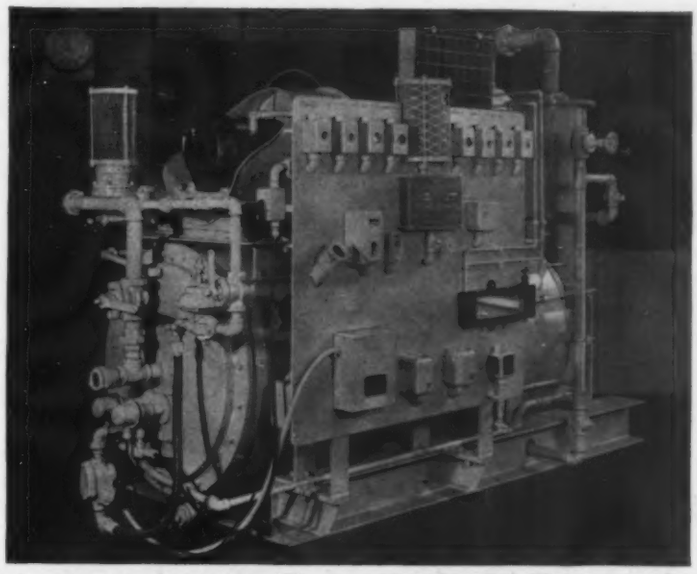
Known as type W-56, the new electrode operates satisfactorily on either alternating current or direct current, reverse polarity, and its range of current is sufficiently broad to cover a wide range of plate thicknesses. A medium-long arc is recommended for best results with this electrode. It can be used in the flat, vertical, and overhead positions. Moreover, it produces a relatively flat deposit, particularly in the vertical position.

Features of the new electrode include a stable spray-type arc, deep penetration, and excellent creep-resisting qualities. In addition, the covering used produces an easily removed, light, friable slag, which sets up fast, thus facilitating proper manipulation of the electrode. Available in sizes $\frac{1}{8}$, $\frac{5}{32}$, and $\frac{3}{16}$ in. in diameter, the new electrode meets the requirements of AWS classes E7010/E7011 and complies with the Navy Bureau of Ships specifications 46E2.

ANOTHER PRODUCTION AWARD FOR LINCOLN

▲ A fifth Army-Navy E Burgee bearing four production stars was awarded to the Lincoln Engineering Company, St. Louis, in recognition of an additional six months of outstanding achievement in the production of war equipment.

The Lincoln Engineering Company was one of the first manufacturers in the 7th Ordnance Corps Area com-



Avoid FIRES & EXPLOSIONS *Prevent* OXIDATION *Protect* PROCESSES

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Pipelines	Oil and solvent storage tanks	Pulverizers
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Available in standard models in capacities ranging from 1,000 to 100,000 CFH—**larger sizes and special models built to order.** All models feature:

(1) **Flexibility**—gas production automatically responds to demand at any rate up to 100% of capacity—thus frequently eliminating need for gas holders to handle peak loads.

(2) **Economy**—fuel gas consumption also varies directly with demand—no wasteful venting.

(3) **Safety**—electric ignition, safety pilot, soft-heads, safety purging on start-up or shut-down, and automatic shut-down in the event of (a) burner outage (b) cooling water failure, (c) power failure, or (d) fuel gas failure.

(4) **Closely-controlled, high quality INERT-GAS** with not over ½ of 1% O_2 or, at operators option, CO.

(5) **Automatic operation.**

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A complete line of Industrial Burners, and Fire Checks.

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KEMP of BALTIMORE

prising eight and a half mid-western states to receive the initial Army-Navy E Burgee.

The company, previous to the war, manufactured a complete line of lubricating equipment and accessories for automotive, industrial, and agricultural applications, but as early as May 1, 1941, Lincoln made available to the United States Ordnance Department its entire engineering and production facilities including its considerable patent holdings.

In addition to being the first concern to manufacture 20mm shells, Lincoln is building lubricating equipment for military combat and transport vehicles, and has designed and produced many special types of equipment at the request of the United States Ordnance Department. Outstanding among these developments is the Lincoln Bullneck grease fitting, designed to replace four other type fittings previously used on military mechanized equipment. The Bullneck fitting is now used as standard equipment on all combat and transport vehicles used by the armed forces.

PREFABRICATED OVENS FOR INFRARED HEATING

▲ A new line of Raymersion prefabricated infrared ovens, which will be of interest to all types of industry where low temperature heating finds application, has been announced by The Trumbull Electric Manufacturing Company, Plainville, Connecticut.

The Raymersion ovens for high speed heating in low-temperature industrial service have the special feature of prefabrication, so standardized as to permit the widest range of utility in the size of the oven for any type of product, any heating capacity and any handling method.

Temperatures as high as 500 F can be obtained, often in seconds, depending on the type and mass of products involved. Combining the advantages of convection and zoned heat application, baking schedules are often reduced as much as 90 per cent. The ovens are made up entirely of such standard parts as frame members, wall panels, ventilation ducts and conventional control equipment. Ovens of virtually any size, shape and heat capacity can be constructed for batch or continuous heating processes in combination with trolley, belt or other types of material-handling equipment.

ELECTRODE PREVENTS UNDERBEAD CRACKING

▲ Metal and Thermit Corporation, New York, New York, has announced the successful development of a new arc-welding electrode that is proving of value in a number of applications.

Known as Murex type HTS, the new product is a mineral-coated electrode with less penetrating arc than so-called "hot rods." The weld metal produced is of high tensile strength, with the ductility and X-ray soundness of metal produced by downhand electrodes.

The new electrode was developed primarily to prevent underbead cracking in the welding of high tensile steel plate, such as that used for certain classes of ship construction. Because it minimizes pick-up of undesirable elements from the parent metal and prevents cracking and porosity in the weld, it is also being found useful in welding "dirty steels" or steels containing impurities, as well as in welding cold-rolled, high carbon and high sulphur steels and free-machining steels used for mechanical molds. In some applications it is being used successfully in place of the more expensive stainless steel electrodes.

INSTRUMENT CHECKS PURITY OF GASES

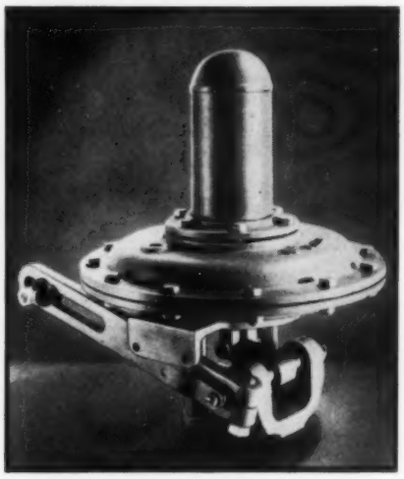
▲ A special analyzer for testing the high purity of oxygen, carbon dioxide, and nitrogen in the range from 90 to 100 per cent has been announced by The Hays Corporation, Michigan City, Indiana.

It is of particular interest to the manufacturers of commercial oxygen and carbon dioxide but has many practical uses also in industrial processes. The new analyzer, known as the Hays series E, came into being as the result of the demand for testing the high purity of oxygen for use in flying, etc. It is quite similar to the standard orsat but its technique in operation differs somewhat.

It is offered in two styles — a wall mounted model for permanent installation and a portable model supplied in a neat metal case with leather carrying handle. It may be had with a single unit or with two units. A junior model (series EJ) is also obtainable with a burette capacity of 30 cc. The smaller model measures 6¼ in. x 9⅝ in. x 3¾ in. and weighs, fully charged, less than six pounds. All models feature a new four-way valve designed by Hays engineers to conserve space and facilitate operation. An explanatory bulletin (Pub. 45-743) will be sent to those interested.

DIAPHRAGM MOTOR FOR VALVE OPERATION

▲ A pneumatic diaphragm motor, announced by Conoflow Corporation, Philadelphia, Pennsylvania, is especially designed for use in conjunction with throttling type pneumatic control instruments to operate rotary stem valves and similar mechanisms. Its novelty lies in the use of an outboard type of lever connection to the valve, thereby permitting mounting of the motor directly over the valve body rather than eccentrically.



It is unusually compact, has a low center of gravity, and when used with a pneumatic valve positioner is powerful enough to operate valves up to eight inches in size. The operating lever can be clamped in any position of the lower 200 degree arc, and, if desired, an additional lever can be attached to the other end of the shaft.

MATS OF BONDED GLASS FIBERS FIND NEW USES

▲ Thin, porous mats of bonded glass fibers, originally developed for use as retainer mats in storage batteries and widely employed for this purpose, have now been successfully applied to a number of entirely new uses by the process and electrical industries.

In roll form, the Fiberglas mat is being employed as a material for wrapping underground oil, gas and other pipe lines to protect them

against corrosion and electrolytic action. The material can be wrapped around bitumen or coal tar-coated pipe, thus forming a continuous water-tight bond.

The glass fibers are non-corrosive to metals. The material has negligible moisture pick-up. Its tensile strength is preserved through a wide range of temperatures and exposure to organic solvents and soil acids. The millions of fine intertwined glass fibers reinforce a large amount of bitumen or coal tar coating for a given thickness of wrapping, as compared to other carriers.

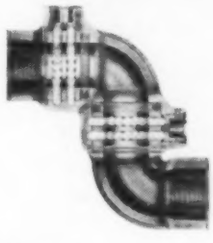
Primarily because of the high tensile strength and non-hygroscopic characteristics of the individual glass fibers, the Fiberglas mats are being employed as the base for a new plastic laminated material. Possessing a low and stable loss factor over a wide frequency range, the laminate greatly extends the field for plastic coil forms, condenser spacers, stand-off insulators, etc., in radio, television and other high-frequency electronic devices.

In building up the laminate, the Fiberglas mats are impregnated with a thermo-setting aniline-formaldehyde resin, and are cured under high pressure. In addition to its low loss factor, the laminate possesses high strength, high temperature resistance, dimensional stability and resistance to fungus attack. Good machinability is another important property of the laminate.

Fiberglas mat is also being employed as a base material for gaskets and sheet packing. The mat acts as a carrying medium for synthetic resins suitable for applications requiring resistance to heat, oil and acids. Glass-base gaskets now being manufactured show high pressure resistance, good chemical durability and little flow under flange pressure.

Made by Owens-Corning Fiberglas Corporation, Toledo, Ohio, Fiberglas mat is composed of fine glass fibers intertwined in random orientation and bonded together to form a thin, highly porous, felt-like material. The glass fibers have an average diameter of .0005 in. Several types of binders — starch, gelatine, furfural or phenolic — may be used, depending upon the requirements of the end use.

Mats are produced in thicknesses ranging from .01 in. to .05 in., and in standard widths of 22 and 36 in. in roll lengths of 150 and 300 ft.



CHIKSAN FORMULA FOR PERFECT FLEXIBILITY:

$$BB_2 + EP = \frac{P/V}{LT}$$

BB_2 = Double Rows of Ball Bearings
EP = Effective Pack-Off
P/V = Pressure or Vacuum
LT = Low Torque

With oil wells going deeper and deeper, it may not be long until depths are stated in miles... not feet! Drillers get more miles of service per foot of rubber rotary hose by using a CHIKSAN *Ball-Bearing* Swivel as end connection (shown in photo above). You can protect your rubber hose and make it last longer, too, by using Chiksan Swivels for connection to gas, oil, air or water outlets... and on all hose reels. Over 500 different types, styles and sizes for every purpose. Write for Catalog.

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BALL BEARING SWIVEL JOINTS FOR ALL PURPOSES

CHIKSAN COMPANY
BREA, CALIFORNIA

CONCENTRATION METHODS FOR LOW GRADE IRON ORE

▲ Seeking richer materials for the modern blast furnaces of the South — a step toward insuring the economic future of this region's great iron and steel industry — the Bureau of Mines has developed two promising methods of concentrating the low-grade red iron ores of the Birmingham, Alabama district.

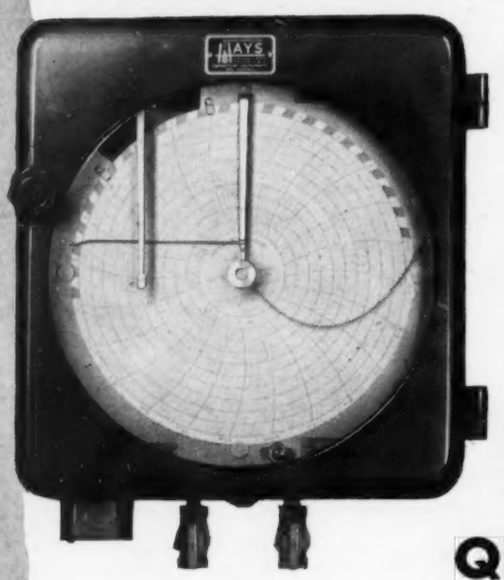
Pilot plant and other tests conducted over several years with these methods indicate that many of the calcareous red ores will yield marketable-grade concentrates with good recovery, although the methods have their limitations and cannot be considered cure-alls.

Reserves of self-fluxing and high-lime ores are being depleted by the war, and the operators ultimately will face the necessity of treating lower-iron and higher-silica ores in the furnaces. Operating furnaces with greatly increased slag burdens and reduced iron output is not economically attractive, even under the favorable conditions existing in the district, and the companies are becoming increasingly interested in the possibilities of beneficiation to prepare higher-grade furnace feed.

Batch tests and continuous trials in a laboratory pilot plant were supplemented by similar trials at an experimental gravity concentrator operating in the Birmingham district, and the results confirmed the laboratory tests.

A detailed description of the methods may be obtained from the Bureau of Mines, Department of the Interior, Washington 25, D. C., in publication R. I. 3799, "Beneficiation of Iron Ores by Flotation. Part 1 — Anionic Flotation of Silica from Calcareous Red Iron Ores of the Birmingham District, Alabama."

For better steel.. and more of it



this recorder of facts *helps control* STEEL QUALITY

YOU find Hays Series "OT" Pressure Recorders on many new and modernized open hearth installations—and for just one purpose: to make a permanent record of furnace performance. Guesswork is eliminated, man power saved, and rejects cut to the minimum.

On the 10-inch 24-hour charts you can have a record of two draft values, two pressure values, two differential values or any combination of two of those three values.

Here's a simple practical means to more effective control of steel quality. Better get the facts about it—send for Bulletin 43-586.

The HAYS CORPORATION
COMBUSTION INSTRUMENTS AND CONTROL
MICHIGAN CITY, INDIANA, U.S.A.

DRAFTING ROOM PRACTICE TO BE COORDINATED

▲ Army, Navy and industry representatives have met with the American Standards Association to form a committee that will tackle the huge problem of more completely coordinating drafting room practices. The armed forces and industry have much to gain from the job through the speeding up of production resulting from a single procedure in respect to drawings. Initial production and design changes will be simplified by standardization of form and interpretation. This move to develop uniform standards is backed by a joint directive of the Secretaries of War and Navy to their departments.

The Army and Navy have already set up committees within their jurisdiction to unify the practices in the various branches of the Services and have authorized the American Standards Association to coordinate this activity with industry.

Due to the present lack of uniformity in drafting room practices a contractor is frequently required to make sure that his own organization, as well as his subcontractors, make the necessary adjustments between the varied practices involved. Uniformity will permit a more effective use of technical personnel engaged in the work.

A joint Army-Navy committee has already outlined the initial scope of much of the job ahead which will deal with the following subjects in the fields of civil, mechanical, electrical, aeronautical, and marine engineering:
1. Abbreviations.

2. Methods of indicating and specifying threads.
3. Method of lettering.
4. Drawing forms and sizes.
5. Graphical, diagrammatic and schematic symbols.
6. Methods of indicating and specifying materials.
7. Methods of indicating and specifying finishes.
8. Methods of dimensioning and indicating tolerances.
9. Methods of numbering drawings.

OSCILLOGRAPH RECORDS ELECTRICAL PHENOMENA

▲ For aircraft engine manufacturers, electric power companies and research laboratories, a new self-contained industrial electronic oscillograph which records characteristics of electrical phenomena lasting as little as a fraction of a millionth of a second is announced by Westinghouse Electric and Manufacturing Company.

An instrument of the cold cathode type, the electronic oscillograph is capable of recording single electrical transients with respect to time, or two electrical phenomena with respect to each other, such as voltage versus current, in the form of diagrams produced by two pairs of electrostatic deflecting plates disposed at right angles to one another. The cathode of the tubes is energized from a 50 kv d-c rectifier with a control to correct for line voltage variation. The beam is normally blocked by a target. An impulse synchronized with the phenomena will trip the relay which bends the beam around the target so that it will strike the fluorescent screen or film below.

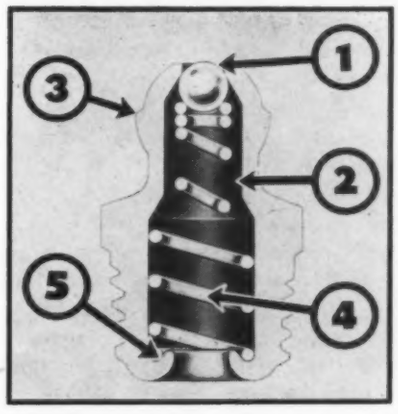
The new streamlined unit consists of the oscillograph proper in front of the cabinet and the cabinet proper which houses all energizing and control circuits. Energizing terminals are enclosed except one bushing connected to the source of synchronizing impulse. Concentrating coils, beam current meter, and leak valve, control the intensity and size of the trace on the film. Deflecting coils move the zero position of the beam so as to use the whole area of the exposed film for the record.

In addition to the fluorescent screen for direct observation, the instrument contains a stationary film holder taking a standard film for recording electrical phenomena lasting 1/1000 of a second or less, and may be operated with a rotating film drum for phenomena lasting from 1/1000 to 1/10 of a second. A photoelectric control which makes it possible to take an oscillogram in one revolution of the drum, regardless of speed, eliminates the possibility of superimposed waves.

LUBRICATION FITTING HAS UNIQUE FEATURES

▲ A new grease fitting known as the Bullneck, developed by the Lincoln Engineering Company, St. Louis, Missouri, is now available for civilian use.

The Bullneck fitting was especially developed by Lincoln at the request of the United States Army Ordnance Department for use as standard equipment on heavy military combat and transportation vehicles. It was designed to incorporate the most desirable characteristics of various types of fittings heretofore used on ordnance equipment so as to permit standardization on one type. The advantages of standardizing on one all-purpose fitting are obvious. Equally advantageous is the fact that only one type of coupler is now needed for contacting the fittings thus reducing to a minimum the important task of lubrication.



Some of the unique features of this fitting, shown in cross-section illustration, include:

1. Flush ball check — Ball check is flush with the top of the fitting preventing dirt and foreign matter from lodging in the opening and being forced into the bearing.
2. Larger grease passage — The new design provides a larger inside diameter permitting greater volume of lubricant flow.
3. Bearing pad for coupler jaws — This pad permits even distribution of wear on both the coupler jaws and the fitting itself.
4. Non-collapsible spring — The inside diameter of the passage in the fitting head is slightly less than the diameter in the fitting body, thus preventing the ball check spring from collapsing under pressure.
5. Spring cannot be forced out — The base of the fitting is designed to form an inverted ring seat channel from which the ball check spring cannot slip. This prevents spring from being forced through the fitting.

Lincoln Bullneck Fittings are machined from steel bar stock, hardened to a uniform maximum degree throughout, and have a heavy zinc plating to withstand the most severe usage. They can be contacted by all standard type couplers.

BOILER CONTROL PANELS NOW PREFABRICATED

▲ Prefabricated boiler control panels which include all necessary connecting piping and electrical wiring for the operation of metering equipment and boiler control systems are now offered by Bailey Meter Company, Cleveland, Ohio, to simplify the user's problem of installation. These panels which are factory fabricated and tested by experienced instrument mechanics are said to save installation time, to insure the use of suitable materials, to reduce total installed cost, and to present a neat, pleasing appearance. All piping and wiring necessary for operation is installed as a unit according to a coordinated and prearranged plan instead of as piecemeal operations by various contractors in the field.

Small units such as valves, relays, switches, signal lights, and the more sturdy and light-weight instruments are mounted and connected ready for service. Heavy instruments or instruments having delicate mechanisms are shipped separately; but cutout spaces, drilling and all necessary connections are provided so that their installation in the field is a foolproof, quick and easy operation.

Connecting piping and electrical wiring are brought to convenient terminals which are carefully tagged so that no time or effort is lost in connecting the prefabricated boiler control panel to the various factors which it controls.

New Literature

▲ A complete summary of information on all the various industrial applications of storage batteries has been issued by the Storage Battery Division of Philco Corporation. This new manual includes a wide range of battery facts running all the way from the proper method of operating and maintaining batteries in the tropics to how best to preserve the life of a battery when not in use. It is not a battery encyclopedia loaded with useless technical facts, but rather a book of practical information which purchasing men, engineers, specification writers and designers of battery powered equipment will find a great time-saver when battery facts are needed.

Large users of storage batteries may obtain a copy of the manual by writing to William H. Maxwell, Philco Corporation, Storage Battery Division, 467 Calhoun Street, Trenton, New Jersey.

▲ A new booklet has just been released by the Hays Corporation, Michigan City, Indiana, manufacturers of combustion instruments and control, entitled "Hays Instruments and Controllers in Industry." It features schematic drawings of typical applications of instruments and controllers to the following industrial control problems: pressure reducing, pressure relief or back pressure, rate of flow, turbine-driven compressor control, and control of speed, liquid level and liquid density. The various instruments and controllers applicable to these problems are illustrated and described in detail. A copy of the publication (Bulletin 45-713) will be sent to anyone interested in the automatic control of industrial processes. Address The Hays Corporation, Michigan City, Indiana.

▲ The De Laval Steam Turbine Company has issued a new catalog devoted to the complete line of steam turbines, helical gears, centrifugal pumps, centrifugal compressors, worm gear speed reducers, and Imo oil pumps made by that company. In addition to briefly describing the equipment, this catalog tells something of the more noteworthy achievements of the company, particularly in the development of high pressure marine propulsion units and in the introduction of centrifugal pumps for water works service. Copies of the catalog may be had by asking for Catalog 1181. De Laval Steam Turbine Company, Trenton 2, New Jersey.

▲ A 4-page folder, outling the services and facilities of Sam Tour and Company, Inc., metallurgists, engineers and consultants, has just been issued. It contains views of the several laboratories housed in the company's own buildings at 44 Trinity Place, New York 6, and lists the nature of assignments undertaken in metallurgical and chemical engineering, metal finishing, corrosion, physical metallurgy and consultations. Copies will be sent free on request.

▲ A new catalog section on its line of open end V-belting has just been published by The B. F. Goodrich Company, Akron, Ohio, and is now available upon request. The catalog section points out that open end V-belting helps insure efficiency and economy on many drives where use of endless V-belts is not practical. Line shaft and other similar drives can be utilized by using this type belting and fasteners.

Rules for successful application of open end V-belting are given, including the method to determine pitch length, allowances for fastener length and for tensions. Limitations of this type installation are outlined, and the fasteners described.

▲ R. E. Uptegraff Manufacturing Company, Scottdale, Pennsylvania, have just issued bulletin No. 114, describing and illustrating the Uptegraff distribution transformers. This bulletin has thirty-two pages and contains more than one hundred illustrations of the Uptegraff distribution transformers. A copy may be had by addressing R. E. Uptegraff Manufacturing Company, Scottdale, Pennsylvania.

▲ Detailed information on the first standard mercury arc converters designed for induction heating operations in the 500-2000 cycle frequency range is presented in a well-illustrated 8-page bulletin just issued by the Allis-Chalmers Manufacturing Company.

How Allis-Chalmers supplies all essential apparatus for complete induction heating installations, including coils, furnaces, and cubicles is explained by a drawing and wiring diagram of a typical mercury arc converter installation. As frequency changer equipment, the Excitron mercury arc converters have a conversion efficiency of 90 per cent or better. Units are built to supply power for induction heating in blocks of 250, 500, and 1000 kilowatts and higher.

Graphs and "exploded" views of the Excitron converter compare it favorably to other types of equipment used for induction heating. Differences between the old way and the new way of heating and melting metals are summarized in quick-reading, illustrated form.

The bulletin, B6373, may be obtained by request from the Allis-Chalmers Manufacturing Company, Milwaukee 1, Wisconsin.

▲ Application of Allis-Chalmers vacuum tube electronic heaters for both induction heating of metals and dielectric heating of non-metallic materials is explained in a well-illustrated, fully descriptive, 4-page bulletin issued by the Allis-Chalmers Manufacturing Company.

How the two types of heating work and the advantages of each are clearly pointed out, and numerous successful applications are indicated. Illustrations of typical production set-ups of the standard 20 kw heater are included.

A list of features of the new Allis-Chalmers electronic heaters announced a few months ago includes a low-loss coupling system to provide adaptability in most applications without the use of radio-frequency transformers, and a three phase rectifier (on sizes 10 kw and larger) to obtain maximum power from the electronic heater and to prevent unbalance of the power line. Automatic timing for each unit operation assures uniform quality of production, with timing pre-determined by test.

The bulletin, B6372, may be obtained by request from Allis-Chalmers Manufacturing Company, Milwaukee 1, Wisconsin.

▲ Bulletin R-181, just issued by The Johnston and Jennings Company, Cleveland, Ohio, describes Rusta Restor, the cathodic (i.e., electrical) method that prevents rusting of steel water tanks, piping, and other steel structures. The bulletin illustrates the action with simple, easy to understand experiments; describes the equipment; includes a table of com-

BOILED DOWN

TO SIMPLIFY MOTOR SELECTION

● This new booklet gives ratings, sizes, characteristics, dimensions, where-to-use data, *and prices* of General Electric a-c and d-c motors, 1/16 to 75 hp. Everything you need to know to select these sizes—all in 16 pages!

Buy all the BONDS you can—*and keep all you buy*

GENERAL ELECTRIC

To Save Your Time Later Mail This Coupon Today—

General Electric Company, Schenectady 5, N. Y.

Please send me a copy of your Condensed Motor Catalog (No. GEA-4281).

Name.....

Company.....

Address.....

City..... **State**.....

750-268-4BB

parative costs, etc. A copy may be had upon request.

▲ Wheelco Instruments Company, Harrison and Peoria Streets, Chicago, has issued a new 12-page catalog on Wheelco electronic controls. Designated Z-6300, it is designed to supply a convenient, condensed listing of principal items of equipment supplied by the company. The bulletin describes the company's electronic principle by which control is effected without contact between measuring and control units of an instrument, and gives brief descriptions and prices of indicating pyrometers and pyrometer controllers, indicating resistance thermometers and resistance thermometer controllers, input controllers, program controllers, portable potentiometers, combustion safeguards, and thermocouples.

▲ The control of harmful vibration from drop hammers, punch presses and other impact machinery through the use of Korfund vibration isolating equipment is the subject of a new 12-page bulletin recently published by The Korfund Company, Inc., of Long Island City 1, New York.

The bulletin points out that unchecked vibration from this type of heavy machinery can crack firebrick and loosen refractory linings in nearby furnaces, weaken building walls and ceilings, destroy the accuracy of adjacent precision machinery, impair the health and efficiency of workers, and shorten the useful life of the impact machine itself.

Copies of this bulletin can be obtained by sending a request on your letterhead to The Korfund Company, Inc., 48-15 Thirty-second Place, Long Island City 1, New York.

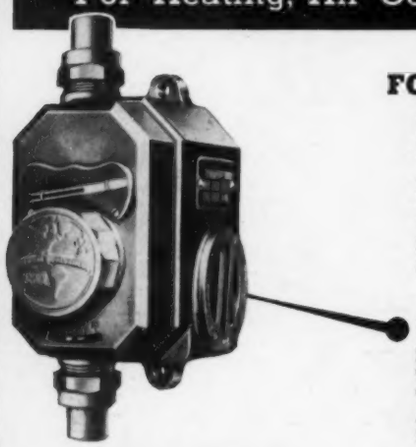
▲ Walker-Jimieson, radio and electronic distributors at 309 South Western Avenue in Chicago, Illinois, have just published a new catalog of radio and electronic equipment. Between its attractive covers is contained pertinent information and data on the most advanced types of electronic instruments, devices and tools. Here are descriptions of products such as industrial X-ray machines, an electronic comparator, test equipment including signal generators, tube testers, and multitesters, photo-electric devices, die-less duplicating tools, plastic sectional wiring systems, and others that have never been cataloged before. This volume, which represents an important contribution to the field of industrial electronics, should enjoy wide acceptance among those responsible for specifying electronic equipment. Walker-Jimieson invites industrial engineers and purchasing agents to send for a free copy

▲ Bulletin No. 560-A, just issued by the Watson-Stillman Company, of Roselle, New Jersey, gives a complete picture of the line of hydraulic equipment built for railroad shops, specifically those machines for locomotive and track repair classified as "miscellaneous equipment." This group includes crankpin and forcing presses, pulling jacks, and rail benders. Each type of machine is fully illustrated and described, with specifications and engineering data. Other Watson-Stillman railroad shop equipment — wheel press, pit jacks, spring shop equipment, bushing presses, drop pit tables and the Walter Stock Adjusting Machine — are covered in separate bulletins. A request on your business letterhead will bring you a free copy of Bulletin 560-A, or any of the others.

CROUSE-HINDS

Thermostat Condulets

For Heating, Air Conditioning, Refrigeration



FOR HAZARDOUS LOCATIONS

Explosion-Proof and Dust-Tight— Suitable for use in atmospheres containing ethyl ether vapor; gasoline, naptha, petroleum, benzol, alcohols, acetone, lacquer solvent vapors and natural gas; metal dust; carbon black, coal or coke dust; grain dust; combustible fibers.

Type HRC

Mercury tube switch.
Threaded flame-tight cover.
Through feed ½-inch union hubs. Either hub can be capped.
Accurate thermometer for indicating room temperature.
Locking arrangement can be furnished to prevent regulating by unauthorized persons.

Listed in Condulet Catalog No. 2500, Section 85, Page 50.3.

Type HR

Contactor snap switch.
Ground surface flame-tight cover.
Reversible. ¾-inch hub can be at top, bottom, or either side.
Accurate thermometer for indicating room temperature.
Regulating knob removable to prevent unauthorized regulating.

Listed in Condulet Catalog No. 2500, Section 85, Page 50.4

FOR NON-HAZARDOUS LOCATIONS

Type FHRC

Mercury tube switch.
Through feed ¾-inch hubs flush with top and bottom of body. Removable plug for either hub.
Accurate thermometer for indicating room temperature.
Locking arrangement can be furnished so thermostat can only be regulated by authorized persons.

Listed in Condulet Catalog No. 2500, Section 50, Page 22B.

CONDULETS, manufactured only by CROUSE-HINDS are the Standard of Quality in the field of electrical conduit fittings.

A Nationwide Distribution Through Electrical Wholesalers

CROUSE-HINDS COMPANY
SYRACUSE, N. Y., U.S.A.

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HOW THE WORLD'S LARGEST, FASTEST, TWIN-ENGINED TRANSPORT *Counts its Calories*

Bowser XACTO Meters Precision-Check Fuel Flow and Consumption for Today's Great Lifeliner, Tomorrow's Great Airliner

They call it the Burma Road of the Air because three-quarters of all the vital war supplies, flown over the towering Himalayas into China, have been transported in the Curtiss Commando.

Little wonder that this mighty twin-engined transport is known as today's great lifeliner, tomorrow's great airliner.

And less wonder that Curtiss-Wright selected Bowser Xacto Meters for testing fuel flow and consumption, gross weights, and center of gravity locations for stability and control for the Curtiss Commando.

Carrying vital cargos of war-winning materiel and personnel over thousands of air miles demands that those vital calculations be measured with hairline accuracy because lives . . . American lives and thousands of them . . . hang in that exacting balance.

Your liquid control problems may not involve lives or battles. But if they do involve costs, production and profits . . . if they call for precision-measurement and control . . . Bowser can make a real contribution. In the Steel Industry, Bowser lubrication for mill stands, pinion gear sets, reduction gears, etc. has been adopted for 90% or more of all steel production in the United States. Bowser coolant systems are equally dominant. For details, address BOWSER, INC., Dept. 13-F, Fort Wayne 2, Indiana.

The Bowser XACTO Meter Installation In The Curtiss Commando

BOWSER

SINCE 1885

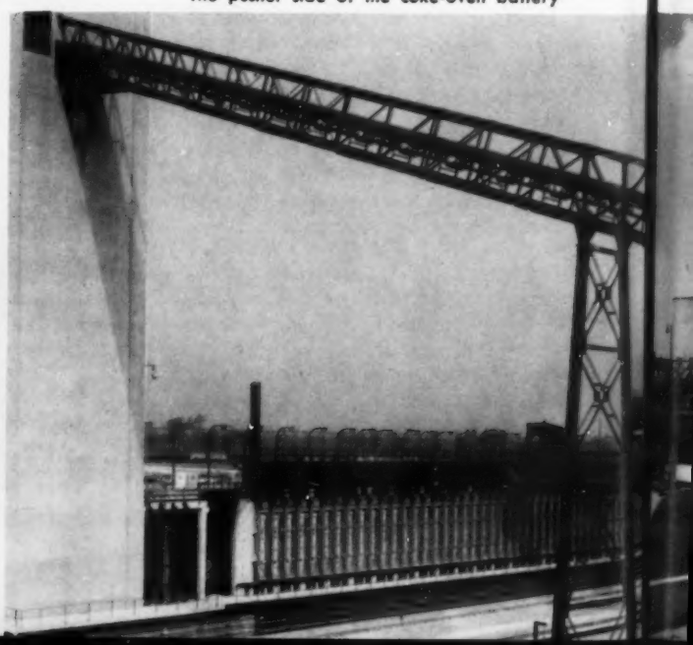
THE NAME THAT MEANS EXACT CONTROL OF LIQUIDS

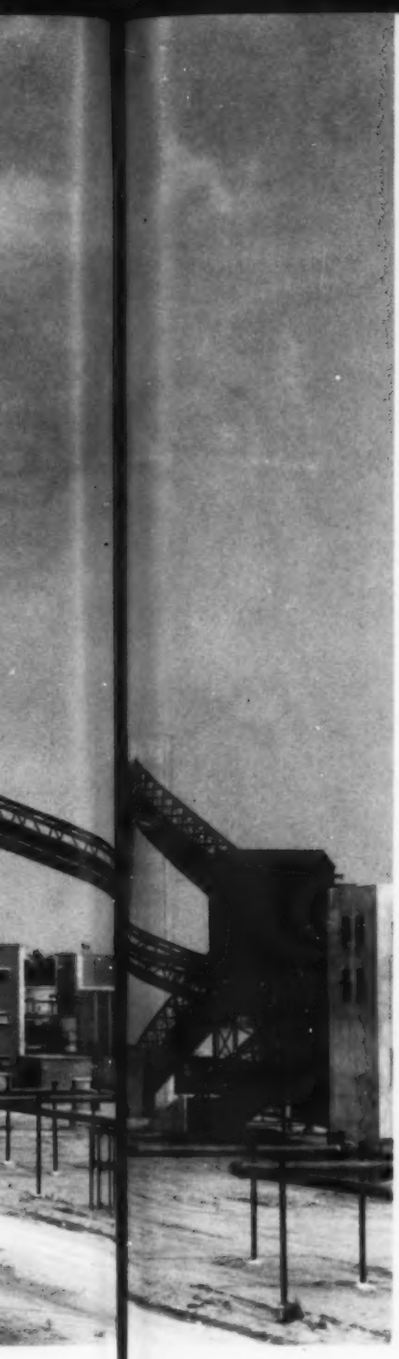
Not only has Bowser's war production earned the Army-Navy E . . . Bowser equipment has helped earn it for scores of other companies.

General view of the plant

The byproduct plant

The pusher side of the coke-oven battery





This

Koppers coke-oven plant

helped meet

a serious problem

A steel mill, built at tidewater in the southwest, to produce steel for the oil fields, was designed to operate almost wholly on scrap from those oil fields. The rapid depletion of the scrap reserves during the war presented a serious problem to the management.

This was overcome by the construction of blast furnace facilities and a coke-oven plant. The coke ovens were built by Koppers and this company also designed and built a small but complete plant for the recovery and refining of other products from the coal carbonization process. The photographs on these pages illustrate the equipment designed and built by Koppers.

KOPPERS

THE INDUSTRY THAT SERVES ALL INDUSTRY

KOPPERS COMPANY, INC.

ENGINEERING AND CONSTRUCTION DIVISION

Pittsburgh 19, Pa.

Buy War Bonds . . . and keep them

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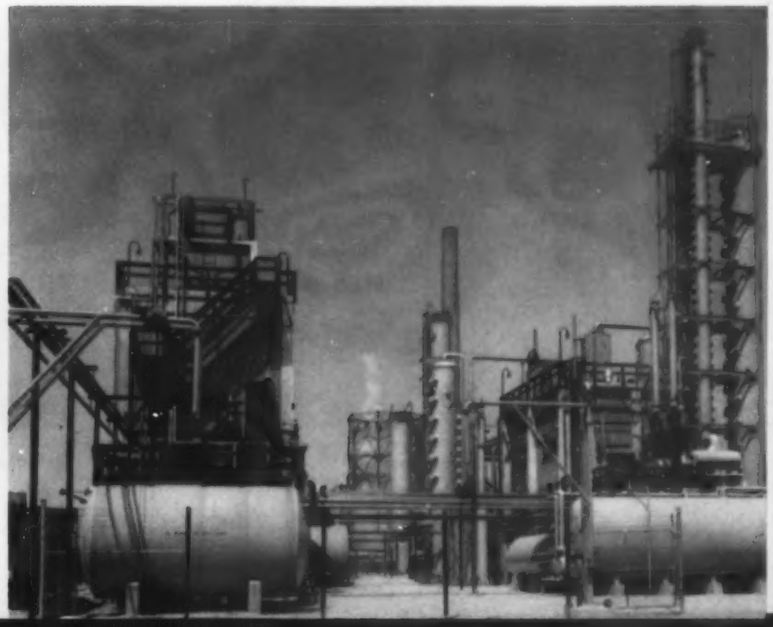
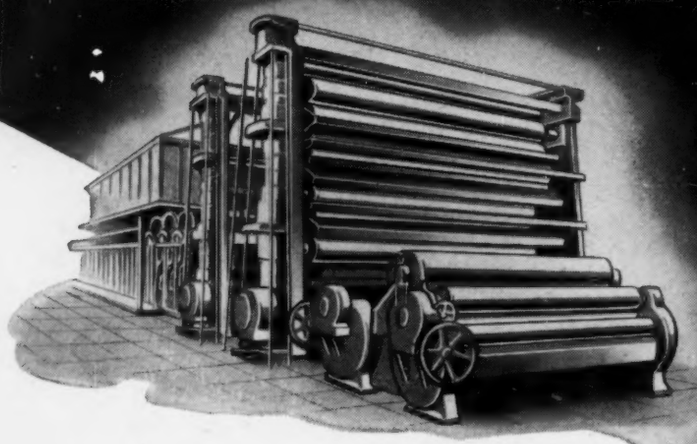
Tanks for refined light-oil products

The light-oil refining plant



ROLLWAY RIGHT-ANGLE LOADING

LONGER BEARING LIFE OVER LONGER PERIODS OF CONTINUOUS OPERATION...



When heavy loads must be carried from 12 to 24 hours a day, let Rollway Solid Cylindrical Roller Bearings do the job. They'll stand up longer, require less service attention. The reason is simple—*right-angle loading*. That means the loads are simplified, too. Broken down into their two simple components of pure radial and pure thrust—each carried on a separate bearing assembly at right angles to the roller axis! There are no oblique loads, no compound resultants; the unit pressures per roller are substantially reduced and the life expectancy of the bearing is relatively increased.

Select Bearings Carefully

Every field of general industry has its own bearing problem. No single type of bearing will prove adequate for every kind of industrial application. Let our specialists help you to select the proper bearing for your needs.

ROLLWAY BEARING CO., INC.
Syracuse, N. Y.
1908-1945

ROLLWAY CYLINDRICAL ROLLER BEARINGS

SALES OFFICES: Philadelphia • Boston • Pittsburgh • Youngstown • Cleveland • Detroit • Chicago • St. Paul • Houston • Tulsa • Los Angeles

Pittsburgh Rolling Mill Meeting - May 14

An attendance of over 500 marked the one-day rolling mill meeting held by the Pittsburgh District Section of the Association of Iron and Steel Engineers May 14 in Pittsburgh. The meeting was ably chairmanned by T. R. Moxley, Wheeling Steel Corporation and John B. Mitchell, Jones and Laughlin Steel Corporation (lower left).

Among those in attendance were E. F. Blank, Jones and Laughlin Steel Corporation, A. J. Fisher, Bethlehem Steel Company and J. L. Mauthe, Youngstown Sheet and Tube Company (left), and John L. Young, National Tube Company, and J. H. McElhinney, Wheeling Steel Corporation (below).

BUILT BY MORGAN *Engineering*

ONE OF TWO MORGAN 200-TON, 63'0" SPAN UNIVERSAL TYPE INGOT STRIPPERS IN A MID-WESTERN ELECTRIC FURNACE STEEL PLANT

The Stripper as illustrated will perform three distinct stripping operations without change in the stripping unit.

(1) Strip small-end-up or standard ingots.
(2) Strip big-end-up hot top ingots.
(3) Break small-end-up ingots loose from stools.

With this type of Stripper it is possible to strip a mixed heat without lost time.

Additional Morgan equipment in this plant includes: Two 300-Ton, 65'0" Span Pouring Cranes. Three 150-Ton, 65'0" Span Pouring Cranes. Two 150-Ton, 80'3" Span Hot Metal Charging Cranes.

THE MORGAN ENGINEERING CO.

ALLIANCE, OHIO. 1420 Oliver Building, Pittsburgh

ESIGNERS • MANUFACTURERS • CONTRACTORS • BLOOMING MILLS • PLATE MILLS • STRUCTURAL MILLS • ELECTRIC
AVELING CRANES • CHARGING MACHINES • INGOT STRIPPING MACHINES • SOAKING PIT CRANES • ELECTRIC WELDED
RICATION • LADLE CRANES • STEAM HAMMERS • STEAM HYDRAULIC FORGING PRESSES • SPECIAL MACHINERY FOR STEEL MILLS

Personnel News

C. M. White has been elected president of Republic Steel Corporation, succeeding **R. J. Wysor,** who resigned to take up important new work said to be in connection with the rehabilitation of the European steel industry as directed by the allied governments and military occupation forces. Mr. Wysor, who has been president of Republic since 1937, will continue as a member of the board of directors.

The new president of Republic, the country's third largest steel company, was graduated from the University of Maryland in 1913. He entered the steel industry in 1915 when employed by Jones and Laughlin Steel Corporation, where he later became associated with Mr. Girdler, former president of that company.

When Mr. Girdler became head of the newly formed Republic Steel Corporation in 1930 Mr. White became assistant vice-president in charge of operations. He was made vice-president in 1935.

E. M. Richards was elected vice-president of operations for Republic Steel Corporation, succeeding Mr. White.

Mr. Richards, a graduate of Bucknell University, entered the steel industry in 1925 as chief industrial engineer for the Jones and Laughlin Steel Corporation. He came to Republic in 1930 in the same capacity, being appointed assistant to the vice-president in charge of operations in 1935 and assistant vice-president in charge of operations in 1939.

Mowry E. Goetz has been named assistant to the vice-president in charge of operations for Republic Steel Corporation. For the past five years Mr. Goetz has been manager of Republic's Chicago district. In his new position he will make his headquarters in Cleveland.

Mr. Goetz was born in Cleveland and graduated from Penn State College in 1917 as a metallurgical engineer. Following his graduation he enlisted in the Army during World War I and rose to the rank of captain in the infantry.

He has been associated with the Northwest Steel and Wire Company, Sterling, Illinois, as general superintendent, and earlier with Jones and Laughlin Steel Corporation as superintendent of the open hearth and rolling mills departments at the Aliquippa Works. He joined Republic in March, 1940.

Charles P. Cutler has been named district manager of Republic Steel Corporation's Chicago operations, succeeding Mr. Goetz.

Mr. Cutler, who has been assistant district manager at Chicago since 1942, is the son of an old English ironworker who emigrated from Staffordshire to the Pittsburgh district before the turn of the century and later worked as a heater in the bar mills at Youngstown and Chicago plants which are now part of Republic.

The new manager started as an office boy at the Interstate Iron and Steel Company plant in East Chicago in 1909 and became plant manager there in 1926. When this plant was abandoned following Republic's acquisition of the property, Mr. Cutler was transferred to Republic's South Chicago plant as assistant superintendent of rolling, finishing and special process departments. He was named superintendent of these operations in 1934, continuing in that capacity until he became assistant district manager.

P. M. Murphy, a superintendent of Republic's Chicago wire mills since 1942, will succeed Mr. Cutler as assistant district manager. Mr. Murphy was formerly with Northwestern Steel and Wire Company and the American Steel and Wire Company.

Walter M. Farnsworth has been named acting assistant district manager of the Central Alloy District, Republic Steel Corporation.

Succeeding Mr. Farnsworth as divisional superintendent in charge of the Canton steel division, blast

C. M. WHITE

E. M. RICHARDS

MOWRY E. GOETZ

C. P. CUTLER

W. M. FARNSWORTH

E. R. JOHNSON

O. A. BAMBERGER

furnace and coke plant, will be **E. R. Johnson,** formerly the district's chief metallurgical engineer.

O. A. Bamberger, who has been superintendent of the Massillon steel plant, has been appointed acting divisional superintendent in charge of the Massillon steel division, blast furnace and coke plant.

Mr. Farnsworth, who succeeds the late **R. F. Horn,** has been in the steel business since 1914. Born in Nashville, Tennessee, he attended public schools in that city and in 1914 joined the Illinois Steel Company in Chicago in its metallurgical department. During the next six years he worked with the chemical laboratory, the electric furnace melt shop, and, at the time he left to join the Timken Roller Bearing Company, was a melter. He held the same position at Timken for five years and since 1925 has been with Republic and its predecessor companies. For 13 years he was superintendent of the No. 1 electric furnace shop, for six years divisional superintendent in charge of the Canton steel division, and for the past year divisional superintendent in charge of the Canton steel division, blast furnace and coke plant.

Mr. Johnson was born in Chicago and attended public schools in Chicago, Detroit and Harvey, Illinois. In 1921 he graduated from the University of Michigan as a bachelor of science in chemical engineering. He received his master's degree in 1922. In that year he joined Central Steel Company and in 1925 entered its metallurgical laboratory. He was made assistant superintendent of the metallurgical laboratory in 1926 and assistant chief metallurgical engineer in 1929. In 1944 he was named chief metallurgical engineer for the district.

Mr. Bamberger was born in Massillon where he attended public schools. Since 1918 he has been with Republic and its predecessor companies in that city. He spent three years in the heat treating department, seven years in the mechanical heat treat department, 12 years as superintendent of the forging plant at Canton, one year as superintendent of the armor plate department, three years as superintendent of mechanical maintenance, and during the past year has been superintendent at the Massillon steel division.

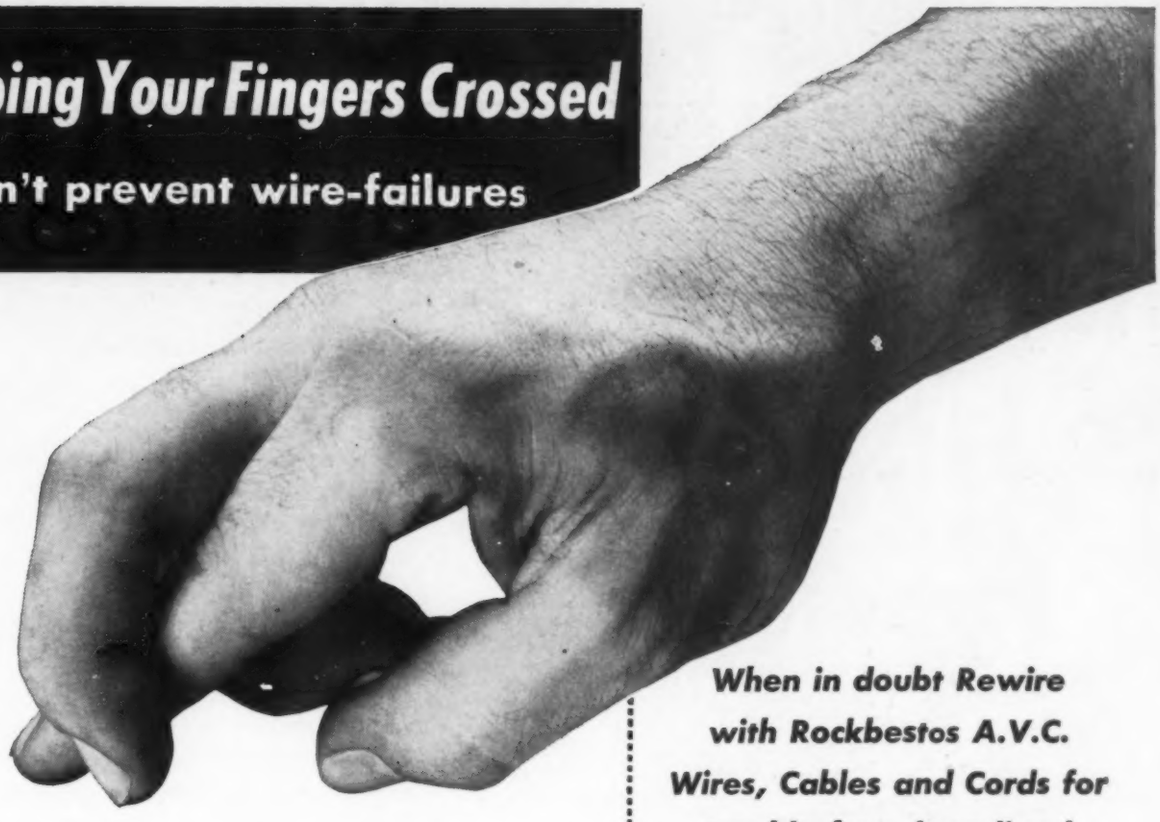
Raymond E. Birch has been appointed director of research of the Harbison-Walker Refractories Company to succeed the late **Fred A. Harvey.** Mr. Birch has been associated with the company since 1930. He graduated in ceramic engineering from Ohio State University in 1927 and received the professional degree of Ceramic Engineer in 1937. His fields of investigation have included pioneering work in vacuum pressing of refractories, the application of thermochemical mineralogy, and development work on silica, magnesite and forsterite refractories. His publications include the chapter on Magnesite in the A. I. M. E. book, "Industrial Minerals and Rocks" and a number of papers on the processing and use of refractories.

A. H. Englund, formerly president and treasurer of Electric Service Manufacturing Company, Philadelphia, Pennsylvania, is now chairman of the board and treasurer of the company. **H. G. Lewis,** formerly vice-president and general manager, is now president and general manager. **Russell Kreinberg** has been made

(*Please turn to page 130*)

Keeping Your Fingers Crossed

won't prevent wire-failures



Do you hope for the best and expect the worst when you think of the war-time beating some of your power, control and lighting circuits have been taking for the past 4 or 5 years? Wiring installed in tough locations when you had to use anything you could get—even though it wasn't built to take overtime abuse under high ambient temperatures or baking overloads?

Then don't wait for trouble! Protect plant operations and production schedules by rewiring circuits that are ready to blow with Rockbestos A.V.C. wires and cables. They are designed to give trouble-free service under severe operating conditions. And they stand up where other wires fail because their *permanent* impregnated asbestos insulation is resistant to heat, flame, oil, grease, moisture, alkalies and corrosive fumes and won't bake brittle, crack, flow, de-center, rot or swell.

Play safe! Put wire-failure insurance into trouble making circuits by installing Rockbestos *permanently insulated* wires, cables and cords. For recommendations, a catalog or samples, write to the nearest district office or New Haven.

ROCKBESTOS PRODUCTS CORPORATION
993 Nicoll Street, New Haven 4, Conn.

FOR VICTORY . . . BUY WAR BONDS

ROCKBESTOS A.V.C.

The Wire with Permanent Insulation

NEW YORK BUFFALO CLEVELAND CHICAGO PITTSBURGH ST. LOUIS
LOS ANGELES SAN FRANCISCO SEATTLE PORTLAND, ORE.

When in doubt Rewire with Rockbestos A.V.C. Wires, Cables and Cords for trouble-free, long-lived performance

ROCKBESTOS A.V.C. 600 VOLT POWER CABLE
(National Electrical Code, Type AVA—max. operating temp. 110°C.)

Sizes No. 18 AWG to 1,000,000 CM insulated with two walls of impregnated felted asbestos, varnished cambric and asbestos braid. Other constructions for service voltages to 5000.

You can use Rockbestos A.V.C. Power Cable for hot-spot wiring, in conduit or open, around boiler rooms, steam lines, furnaces, etc., and for power leads of heat-exposed electrical equipment as it withstands high temperatures and has ample moisture resistance. Use similarly insulated Rockbestos A.V.C. Motor Lead Cable for motor leads and coil connections.

ROCKBESTOS A.V.C. 600 VOLT BOILER ROOM WIRE
(National Electrical Code, Type AVA—max. operating temp. 110°C.)

Sizes No. 18 to 8 AWG insulated with varnished cambric, impregnated felted asbestos and asbestos braid. Sizes 6 to 4/0 have another wall of impregnated asbestos next to the conductor.

For lighting and control circuits exposed to heat and moisture, oil, grease, corrosive fumes or fire hazard, such as exist around furnaces, ovens, lehrs, soaking pits, boilers, etc., this widely used A.V.C. construction is ideal. Its permanent insulation will not bake brittle, crack, rot, flow or swell.

ROCKBESTOS A.V.C. 600 VOLT CONTROL CABLE

In one to 19 conductors with individuals insulated like Power Cable, cotton braid covered, and cabled with an asbestos braid overall. Standard strandings A.W.G. No. 12—19/#25 and No. 9—19/#22. Other strandings on order.

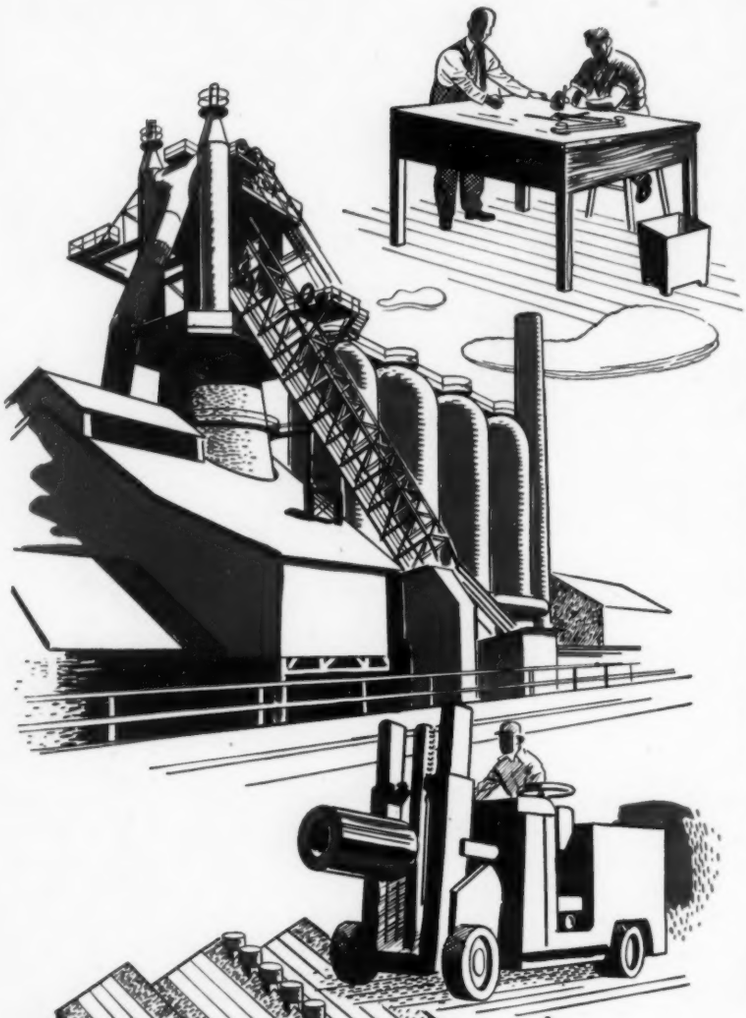
Designed for use in equipment requiring a multi-conductor control cable capable of withstanding high temperatures, this cable is widely used in the control systems of electric cranes and other equipment used in steel mills. The insulation is unaffected by heat, corrosive fumes, oil or grease and has ample moisture resistance.

A few of the 125 different wires and cables developed for severe operating conditions by Rockbestos.

Does the postwar Steel Industry Market interest you?

YOU CAN REACH THE IMPORTANT BUYERS

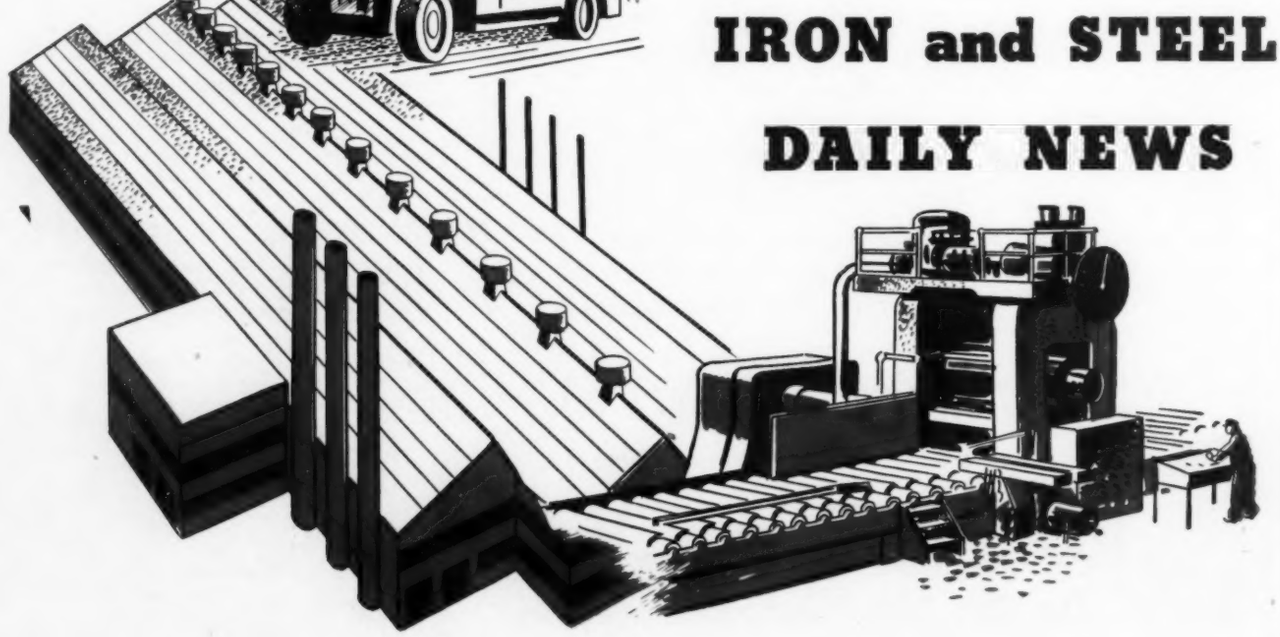
THROUGH



The drawing-boards of the steel industry are literally choked with postwar projects. Some of these will die aborning. That many will develop into constructional reality is assured by the keenness of competition in the steel industry, which prohibits a static condition in methods and equipment.

Postwar projects for rehabilitation and modernization in the steel industry have been estimated as a *billion-dollar program*—a juicy market for the equipment manufacturer. These expenditures, together with the $200,000,000 normally spent each year for plant upkeep, will be controlled by the engineers and superintendents of the steel industry. They are the men who will decide whether your products will be used. They are the men you must convince of your products' superiority. They are the men who will read the

IRON and STEEL DAILY NEWS



Iron & Steel Daily News

Volume 6 — 1010 Empire Building — Pittsburgh, Pa.

PUBLICATION DATE — September 24, 25, 26 and 27, 1945, if a national meeting in Pittsburgh is permissible by that time, or September 26, October 1, 6 and 9 if the program must be broken down into seven individual one-day district section meetings.

DISTRIBUTION — Complete blanket coverage of supervision, from president to foreman, in the iron and steel and allied industries—principally by mail. Some meeting distribution also. Total distribution over 9,000 copies per issue.

FORMAT — A 28 page newspaper, 12½ in. x 17 in. —5 columns per page—black and white. Layout displays ads.

EDITORIAL CONTENT — Current news of "how-to-do-it", new equipment, new developments, new applications, new designs. Pictorial and editorial coverage of fall meeting. Reader interest proven by inquiries.

GROWTH — From 4 pages to 28 or more pages in the five previous years of its existence.

ACCEPTANCE — In 1944, 60 national advertisers used 185 separate insertions.

RESULTS — More than 700 inquiries for additional information were received last year, with many resulting in direct sales to new customers.

CLOSING DATE SEPTEMBER 1

For Ball and Roller Bearings

Insures greatest efficiency and long life. Eliminates pitting and corrosion. Reduces maintenance cost.

Reason: Lubricates instantly without the aid of frictional heat. Strictly neutral, free of acids or alkalies — keeps dust and moisture out of bearings.

Proof: Approved by most manufacturers of anti-friction bearings and used in thousands of plants — after tests of samples.

Used successfully in leading iron and steel mills. Send for instructive bulletins.

•

New York & New Jersey Lubricant Co.

Main Office: 292 Madison Ave., New York 17, N. Y.

WAREHOUSES:

Chicago, Ill. St. Louis, Mo. Providence, R. I. Charlotte, N. C. Atlanta, Ga. Detroit, Mich. Greenville, S. C.

TRADE MARK REGISTERED
NON-FLUID OIL
IN U.S. PAT OFFICE & FOREIGN COUNTRIES

Modern Steel Mill Lubricant

Better Lubrication at Less Cost per Month

vice-president and assistant general manager, and **I. W. Schmidt,** of the company's Chicago office, was named a vice-president in addition to Western manager.

Henning A. Forsberg has been named manager of operations for all works of Continental Foundry and Machine Company, has experienced a long and noteworthy foundry career in his 46 years of life. During the more than 29 years he has been with Continental, he has risen from general office clerk to his present position as manager of operations.

Mr. Forsberg was born in Chicago, Illinois, and attended public school and business college at East Chicago, after which he secured his first job with the Simplex Works of the American Steel Foundries in Hammond, Indiana. In 1915, he started with Hubbard (the name then applied to Continental's Chicago Works) where he did general office work. He was placed at the head of the order department and in 1923 was made production engineer. Five years later he was promoted to assistant general superintendent, and in 1931 became general superintendent, the position he held until his recent promotion to manager of operations for all four Continental works, the Pittsburgh works at Coraopolis, Pennsylvania; the Wheeling works at Wheeling, West Virginia; the Chicago works at East Chicago, Indiana, and Warwood works, Wheeling, West Virginia.

J. Edwin Johnson has been appointed general superintendent of Continental Foundry and Machine Company's Chicago works.

Mr. Johnson was born in Chicago, Illinois. His foundry career began when he served his patternmaker's apprenticeship at the Indiana Harbor plant of the American Steel Foundries. In 1922 Mr. Johnson came to Hubbard, first as a patternmaker and later as a checker, assistant foreman, and assistant to the general superintendent. In 1944 he became sales engineer, the position which he held until his recent promotion.

Frederick G. Schranz has been appointed vice-president in charge of hydraulic and special machinery sales for Continental Foundry and Machine Company. He will have headquarters in the Grant Building, Pittsburgh, Pennsylvania.

Alvin F. Franz has been named general superintendent of the Buffalo plant of the Wickwire Spencer Steel Company.

Mr. Franz was previously general superintendent of the Allan Wood Steel Company of Philadelphia, Pennsylvania, a position he held for 15 years. Previous to that he was open hearth superintendent of the Otis Steel Company of Cleveland, Ohio.

In his new position, Mr. Franz will be in charge of all production at Buffalo, including Wickwire Spencer's open hearth, hot mill and wire departments.

Charles F. Codrington has been appointed assistant to the manager and **A. E. Caudle** has been appointed sales manager of the Allis-Chalmers blower and compressor department.

Mr. Codrington received an electrical engineering degree from Texas A. & M. and worked for the Badger Motor Company before joining Allis-Chalmers in 1930. He completed the graduate training course and also served in the engine and condenser department.

Mr. Caudle is a graduate of Oregon State college in mechanical engineering and worked for the Badger Motor Company before joining Allis-Chalmers in 1939.

H. G. HILTON

H. G. Hilton has been made president of The Steel Company of Canada, Limited, succeeding **Ross H. McMaster** who was elected chairman of the board of the company. Mr. Hilton received his technical education at Case School of Applied Science in Cleveland, Ohio, graduating in 1910. He entered his career as a steel maker with Pickands Mather and Company at their blast furnace plant in Chicago and held several other blast furnace operating positions in the United States before returning to his native Canada in 1919 to become assistant superintendent of blast furnaces for The Steel Company of Canada, Limited, in Hamilton, Ontario.

He became successively superintendent of blast furnaces, assistant manager of Hamilton Works, and in 1934 manager of Hamilton Works. Eight years ago Mr. Hilton was appointed vice-president of the company, was appointed a director in 1941 and in 1943 executive vice-president.

L. E. Stacey, field engineer of the Pittsburgh district office, has been transferred to Wheeling, West Virginia, as a resident field engineer. Mr. Stacey graduated from North Carolina State College in 1940 and completed the company's graduate student course before coming to Pittsburgh.

H. O. Anderson, former general sales manager of the Rockbestos Products Corporation of New Haven, Connecticut, has been elected vice-president in charge of sales. A native of Worcester, Massachusetts, Mr. Anderson came to Rockbestos in 1927 following previous association with the wire and cable industry.

John Kennedy Beeson, who, as a lieutenant-colonel, recently completed his duties with the United States Strategic Air Forces in Europe, has been elected executive vice president of the Pittsburgh Steel Company.

Col. Beeson is the son of the late Charles E. Beeson, one of the original founders of the Pittsburgh Steel Company. A graduate of Yale University, Col. Beeson was vice-president in charge of sales for Pittsburgh Steel

(*Please turn to page 134*)

IS YOUR POWER

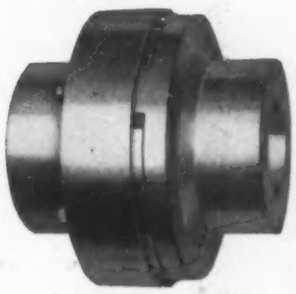
There is no more vital factor of power transmission than the couplings. Careful choice then, of flexible couplings designed and constructed for maintenance of full smooth silent power flow, pays in performance and protection.

L-R FLEXIBLE COUPLINGS

- Resilient load cushions of various materials each particularly adapted to its service.
- Cushions suspended between rugged metal jaws free to adjust to every emergency.
- Efficient correction for misalignment — whip — backlash — chatter. Take up shock, surge, vibration, overloads, etc.
- CUSHIONS ALWAYS IN SIGHT FOR INSPECTION. NO SHUTDOWNS FOR CHANGING.
- Never need lubrication.

New! L-R TYPE C

Extension of outside steel collar safeguards fingers and material, and reduces resistance, noise, even airflow. Boltheads concealed yet readily accessible.



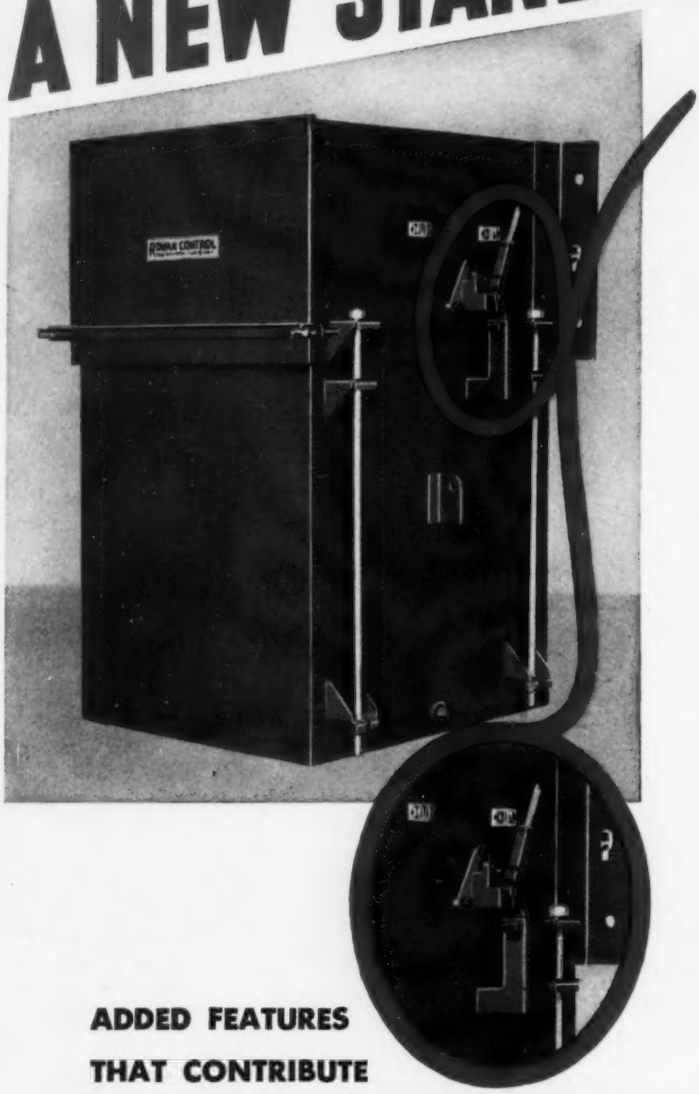
Pat. and Pats. Pending

These L-R Selector Charts should be in every Engineer's File

New Quick-Finding Selector Charts come without charge, with complete L-R Catalog. Charts take you to exact couplings needed for any duty without tedious figuring. Sizes, weights, all engineering data and prices right at hand. Catalog shows couplings for every service, 1/6 to 2500 h.p. WIRE OR WRITE

LOVEJOY FLEXIBLE COUPLING CO.
5016 W. Lake St. Chicago 44, Illinois
Pittsburgh Office: EDW. J. BOYLE CO., 508 Grant Street.

Developed A NEW STANDARD IN SAFETY!



THE ROWAN 900-KBF COMBINATION, OIL IMMERSED, REDUCED VOLTAGE, IMPEDANCE TYPE AC MOTOR STARTER

This up-to-the-minute starter is a *combination* of our reduced voltage impedance starter and oil immersed safety disconnect switch with Rowan Air-Seal Fuses and Seal-Off Compartment for line, motor and control leads. Combining these Rowan advancements into one single unit conserves installation space and costs. *Maximum Safety is provided by mechanically interlocking the operating mechanism of the Safety Disconnect Switch with the Oil Tank.*

Reduced starting voltage is obtained by the use of continuous-wound coils with mechanical adjustment for varying the impressed voltage thereby eliminating tap failures.

The time of acceleration is determined by the motor and its connected load. There is no disconnecting of the motor from the line at any period during acceleration. This assures a minimum of line disturbance.

For safety, smooth acceleration, continuity of service and low overall cost—This ROWAN Type 900-KBF Combination Reduced Voltage Starter "Tops them all." Complete detailed information sent on request.

ADDED FEATURES THAT CONTRIBUTE TO SAFETY, LOW INSTALLATION COSTS AND CONTINUITY OF SERVICE

1. **Safety disconnect switch is completely interlocked with the oil tank in raised or lowered position—positive line disconnection.**
2. **Magnetic overload relays, combination of inverse time element, instantaneous operation—automatic Reset.**
3. **Rowan Air-Seal Fuses—A proven short circuit protection.**
4. **Fully automatic—Push-Button Operated.**
5. **Oil immersed for maximum safety and protection.**
6. **Enclosure is of dust-tight construction.**
7. **Seal-off Terminal Compartment arranged for top and bottom conduit connections.**

More than a generation devoted to the design and manufacture of Oil Immersed AC Motor Controls.

ROWAN CONTROL

THE ROWAN CONTROLLER CO., BALTIMORE, MD.

RESERVED...
For Everyone Interested in
LOWER PRODUCTION COSTS
through Modern Lubricating Systems

Send for this
FREE BULLETIN TODAY!

Lincoln Centro-Matic Lubricating Systems are helping cut production costs in many of the nation's largest industrial plants by providing the ultimate in positive, automatic lubrication. Individual injectors for each bearing • One or a group of machines are supplied by a Single Lubricant Line from the pump • No stopping machines for lubrication • No alterations in machines necessary • No missed bearings.

Include Lincoln Centro-Matic Systems in your "Reconversion Planning" for greater plant efficiency.

Save
BEARINGS
MACHINE HOURS
MAN HOURS
POWER
and Prevent Accidents

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On Lincoln Centro-Matic Lubricating Systems.

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ARMY E NAVY

LINCOLN ENGINEERING COMPANY
Pioneer Builders of Engineered Lubricating Equipment
5701 NATURAL BRIDGE AVE., ST. LOUIS 20, MO., U. S. A.

LINCOLN

when he enlisted in the Air Corps in May 1942. Previously, he had been assistant general superintendent of the company's plant operations at Monessen and Allenport.

T. C. Watts, a director and former superintendent of The Falcon Bronze Company, Youngstown, Ohio, has been named assistant manager in charge of personnel and supplies for the company, and **J. C. Lopatta,** previously general foreman, was made foundry superintendent.

Warner Arms Wick, formerly assistant to the vice-president of The Falcon Bronze Company was appointed assistant manager in charge of production. Dr. Wick was graduated from Williams College in 1932, and was awarded the John Moody Memorial Scholarship to Exeter College, Oxford, where he won first class honors in philosophy. He received a fellowship from University of Chicago, and a Ph.D. degree in philosophy in 1941. Before coming to Falcon in 1943, Dr. Wick taught in the University of Chicago, Dartmouth and Central Colleges.

B. E. Brashares has joined the sales force of The Ohio Steel Foundry Company, Lima, Ohio. Mr. Brashares, who will specialize on miscellaneous steel casting sales for the Lima plant, was recently in the steel casting sales division of Jones and Laughlin Steel Corporation, and prior to that he was sales manager of The Commercial Steel Casting Company, Marion, Ohio.

HERE IS A DESIGN FOR BETTER D. C. MOTOR OPERATION

Seven years of research has proved this new commutator design helps the motor *take it.*

License your plant to have this design *cut* into your commutators to *cut* your maintenance costs.

Eliminates costly burn-outs caused by grounds through the vee rings. Does not change the rating of the motor.

Your inquiries will be taken care of promptly.

MORROW & THOMAS

RD–1

Butler - - - Penna.

John A. Comstock has been appointed director of research and metallurgy for all divisions of the H. K. Porter Company, Inc. He will be in charge of the central research and testing laboratory located in Pittsburgh, as well as individual laboratories for plant control to be located at McKeesport, Pennsylvania, Newark, New Jersey, and Mt. Vernon, Illinois.

Previous to his affiliation with Porter, Mr. Comstock served as engineering metallurgist with the United Aircraft Corporation of East Hartford, Connecticut. He has had directive experience with several concerns including Peoples Gas Company, Chicago, in metallurgical and materials processing lines.

Albert L. Bergstrom has been elected vice-president of engineering for Timken Roller Bearing Company, Canton, Ohio. Mr. Bergstrom, born in Sweden and graduated from Royal Technical Institute in Stockholm in mechanical engineering, came to this country in 1924, and became designing engineer for the Stearns Conveyor Company of Cleveland, Ohio. He remained with Stearns until 1929 when he came with The Timken Company as development engineer. He was given various engineering and development assignments, later became chief works engineer, and in 1938 was made executive engineer. In his new duties as vice-president of engineering.

F. C. T. Daniels, vice-president of Mackintosh-Hemphill Company, Pittsburgh, Pennsylvania, has been elected a director of the Fort Pitt Bridge Works, Canonsburg, Pennsylvania.

Colonel G. deFreest Larner has been appointed assistant to the president of H. K. Porter Company, Inc., as announced recently. Colonel Larner will have charge of termination of war contracts, renegotiation, and special tax problems.

An ace in World War I, Colonel Larner has recently returned to inactive status after more than three and one-half years of duty with the Army Air Forces both in England and the United States.

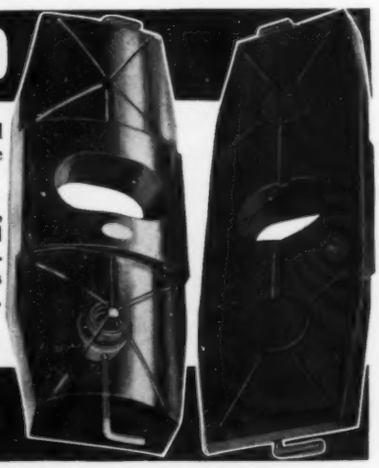
Colonel Larner was formerly a deputy administrator of NRA and has been connected with the Business Advisory Council in Washington. Prior to this time he was associated with the Guaranty Trust Company of New York and the banking firm of Brown Brothers and Company.

BEARING BOTTLENECKS ELIMINATED

GATKE Moulded Fabric Bearings have proved that delays can be avoided and costly machine shop work eliminated.

From the largest, to the smallest roll necks, table rolls, Universal Couplings, Cranes and other tough service—GATKE Bearings are effecting improvements that are so tremendous they must be experienced for full appreciation.

Particulars on request.



GATKE CORPORATION - 228 N. La Salle - CHICAGO

Richard H. Rowland, vice-president in charge of the National Battery Company's Gould Industrial Division, Depew, New York, will assume the added responsibility of general sales manager, succeeding **John C. Sykora,** resigned.

Mr. Rowland, a Michigan alumnus, was vice-president of the St. Paul Engineering and Manufacturing Company prior to his recent connection with the National Battery Company. In addition to his general administrative responsibilities, he will direct the operations of Gould's entire sales and service field organization.

Mr. Sykora, whose resignation terminates twenty-six years of Gould service, has been appointed director of sales, Portable Products Company, New York. At the time of his resignation, he was vice-president in charge of sales for Gould.

J. C. Schaefer, field engineer of the Allis-Chalmers Pittsburgh district office, has been appointed branch office manager at Youngstown, Ohio. He will succeed **E. H. Legler,** who has been transferred to the electrical department at Milwaukee, Wisconsin. Mr. Schaefer graduated from Purdue University in 1935 and, after completing the Allis-Chalmers graduate student course, was transferred to the company's Pittsburgh office.

Obituary

EDMUND A. DOYLE

Edmund A. Doyle, consulting engineer for The Linde Air Products Company a unit of Union Carbide and Carbon Corporation, died suddenly May 4. He was 64 years old.

Mr. Doyle was born in Baltimore, Maryland, on January 13, 1881. He received his early education at Baltimore and was graduated from Johns Hopkins University as a mechanical engineer.

Mr. Doyle began his association with The Linde Air Products Company in 1922 as assistant general sales manager in charge of service. Four years later he became consulting engineer on process development, a position he held until his death.

CRANE BUILDERS Since 1903

BEDFORD CRANES

Capacities 5 to 150 Tons

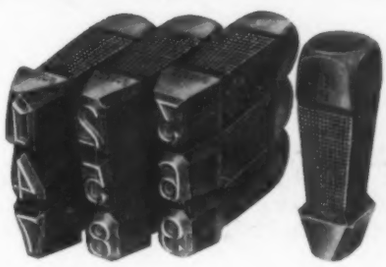
Designed and Engineered to Meet Your Requirements

Any Span or Lift
Send For Your Copy Of Catalog

ELECTRIC OVERHEAD TRAVELING CRANES
GANTRY CRANES • STEEL DERRICKS
BUILT TO YOUR SPECIFICATIONS
STRUCTURAL STEEL • STEEL BUILDINGS
AIRPLANE HANGERS

BEDFORD FOUNDRY & MACHINE CO.
Engineers Designers Fabricators
BEDFORD, INDIANA U. S. A.
Gray Iron Castings

Help prevent an accident today!
CUNNINGHAM
SAFETY (Reg. Trade Mark) Wedge Grip
LETTERS and FIGURES



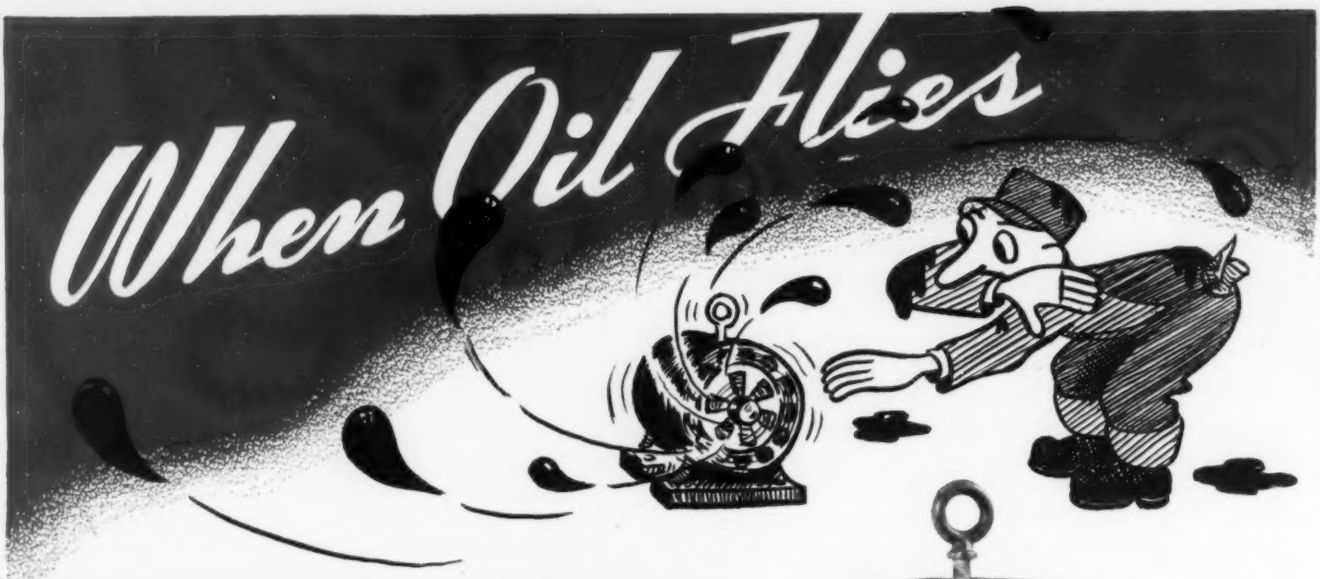
- No mushroom
- No spall
- 25% to 50% more service
- More Safety!
- Pat. No. 2,089,794

Perfect balance . . . Knurled sides not only assure *positive* grip with "Wedge Grip" to give clearer, deeper impressions—but also lessen severity of extra heavy stamping. Characters available from 1/16" to 1".

Have you the new Cunningham Safety Marking Tool folder?

M.E. CUNNINGHAM CO.
SAFETY STEEL STAMPS
106 EAST CARSON ST., PITTSBURGH, 19, PA.

When Oil Flies



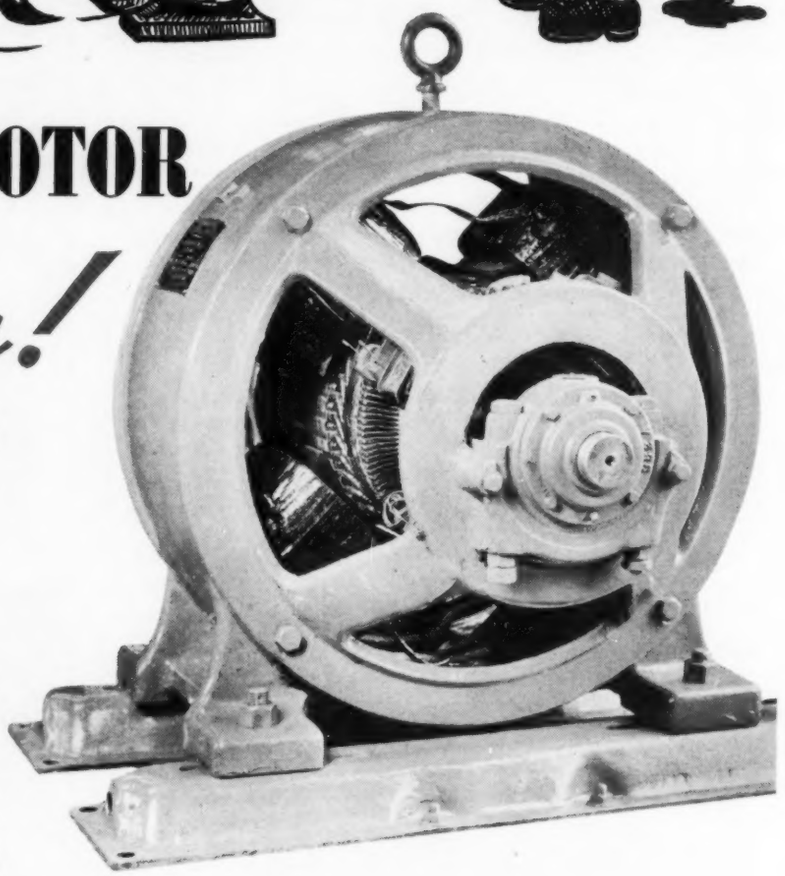
YOU'VE GOT MOTOR *Troubles!*

The KEYSTONE Ball Bearing END BELL

is Grease Packed — No Oil to Escape — Keeps Commutator and Mica Cone Clean. The Motor Operates Much More Efficiently with Greatly Reduced Maintenance Costs!

Flying oil from sleeve bearing motors is one **certain** cause for much of the motor maintenance troubles being experienced in industry today . . . and the Keystone End Bell ends this trouble completely!

To give your motors a new lease on life — to eliminate expense and time-consuming motor breakdowns, write or call — thousands of motors of all types and sizes can be successfully converted with the Keystone End Bell. Our experienced engineering staff can give you full data as it applies to your problems.



This famous motor represents an outstanding example of the Keystone End Bell conversion. Designed as a sleeve bearing motor, its efficiency is soon impaired by lubricating oil on the commutator and mica cone. When converted, this motor's efficiency is restored and the conversion cost soon offset by eliminated maintenance costs.

Bearing Specialists

The OHIO BALL BEARING Co.

BALL-ROLLER and THRUST BEARINGS

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BRANCH OFFICES: Canton, Dayton, Columbus, Akron, Cincinnati, Youngstown, Charleston, Wheeling, Fort Wayne, Indianapolis, Muncie, Terre Haute

PITTSBURGH PIPE CLEANER COMPANY

A Name to Remember when . . .

- Water Flow in Cooling Coils Becomes Uncertain.
- Home Made Pipe Cleaning Methods Don't Work.
- Sewer Lines Clog.
- Pumping Pressures Increase.
- Heat Transfer Units Become Inefficient.
- Fire Line Capacity Drops.

PITTSBURGH'S CONTRACT PIPE CLEANING SERVICE

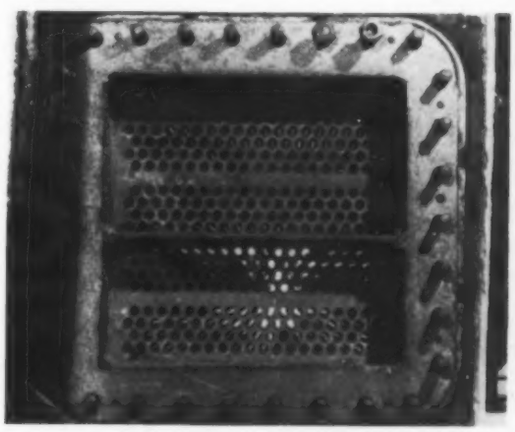
Offers to the IRON AND STEEL INDUSTRY:

EXPERIENCE —The benefit of our experience on thousands of Pipe Cleaning Contracts.

SKILLED SUPERVISION —Intensive and extensive training of our men insure best results.

EQUIPMENT —Constant development of designs based on research and results in the field.

Photo taken at theatre in Philadelphia showing condenser tubes after cleaning by Pittsburgh Pipe Cleaning Service.



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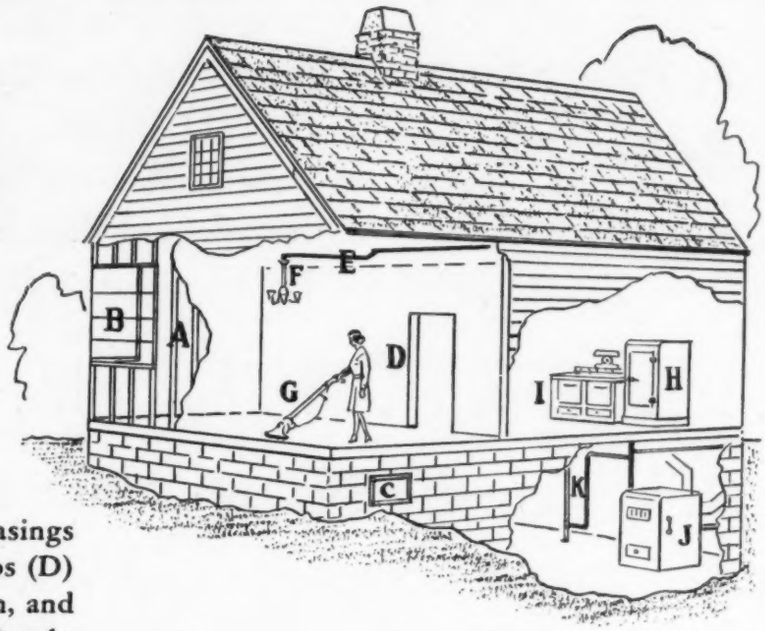
COMPONENTS FOR "HIGH-DEMAND" SPECIALTIES AT LOW-COST ON *Yoder* MACHINES • • •



● **For example, consider the many sections that can be formed on Yoder Cold-Roll-Forming Machines, some of the most common every day uses of which are illustrated in the schematic drawing at right.**

Structural forms, such as angles or channels, suitable to steel frame construction (see "A" in illustration) can be produced in quantity at low cost on a YODER machine . . . The same is true of steel sections for window frames (B) or basement chute casings (C): Steel reinforcing or binding strips (D) for various types of wall construction, and metal conduit for electrical wiring (E), tubing for electrical fixtures (F) or vacuum cleaners (G) can be manufactured in profitable quantities on YODER equipment.

In modern design of refrigerators (H) and stoves (I) and furnaces or air conditioning units (J) framing with low-cost angles or channels opens a big market for such sections. YODER machines produce this type of fabricating material as well as all kinds of mouldings very economically. Tubing and pipe for household plumbing (K) and for industrial use cannot be produced by any better method than on YODER mills. Yoder forming machines also make tubing suitable to the manufacture of modern furniture, bicycles, hospital equipment, as well as special sections for making folding chairs, and folding tables, and many strips and mouldings for radios, electrical control panels, automobiles, etc. Machines for high speed cutting off of formed sections, tubes, rods are also available.

In addition to making all types of high production metal working machinery Yoder offers a complete engineering and designing service, can develop and build complete manufacturing plants. Further information is available to you on request, either in bulletins on special lines or by consultation. Write to

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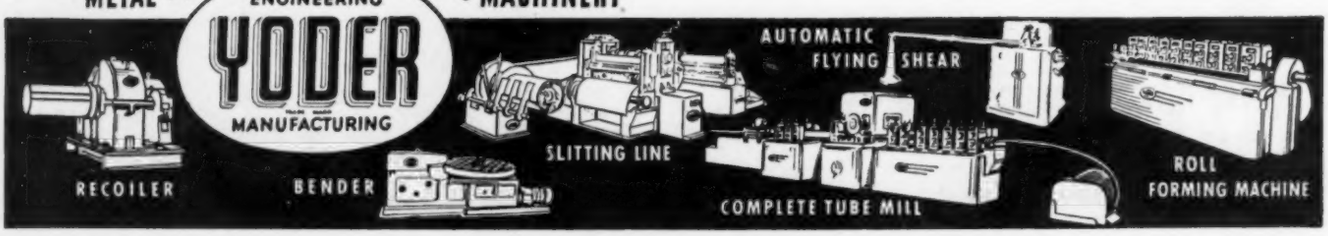

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THE MIGHTY 7th WAR LOAN

The Treasury Department acknowledges with appreciation the publication of this message by

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You will want the complete story of the Model 420 Indicating Pyrometer as given in Bulletin 1213. Thermocouples, Protection Wells and Lead Wires for use with it are covered in Bulletin 1211, and if you plan to use it as a Radiation Pyrometer for temperatures up to 3600°F. be sure to ask also for Bulletin 1202.

Address The Bristol Company, 123 Bristol Road, Waterbury 91, Conn. (The Bristol Co. of Canada, Ltd., Toronto, Ontario. Bristol's Instrument Co., Ltd., London, N. W., 10, England.)

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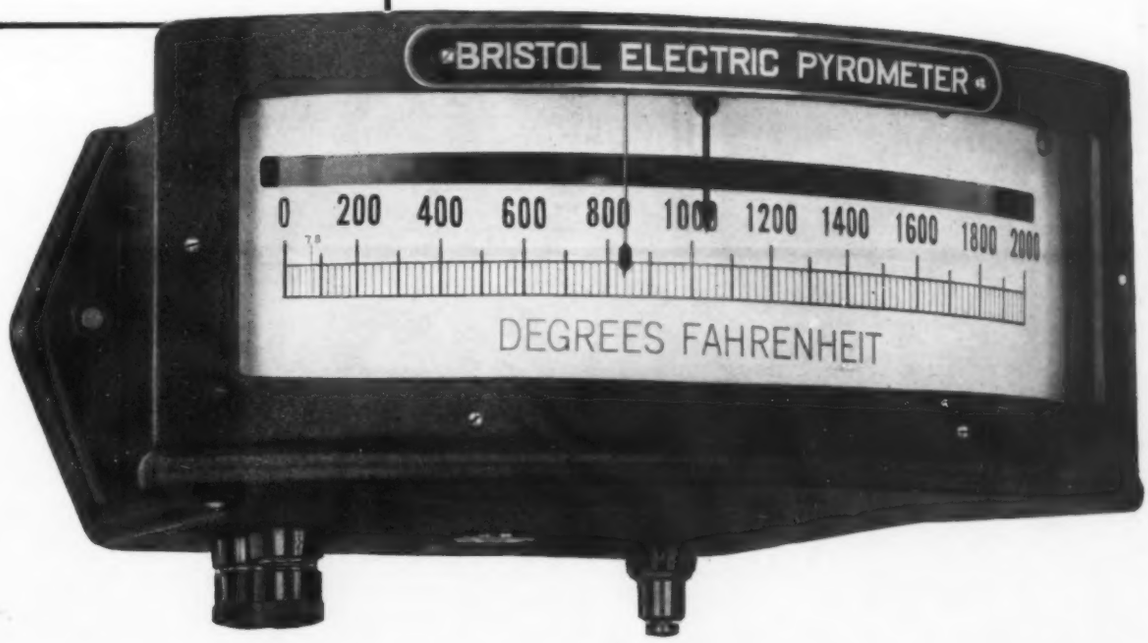

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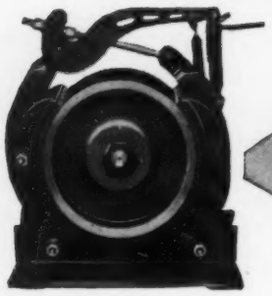
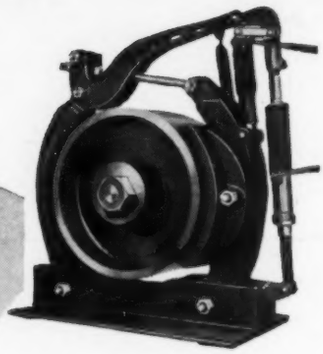
Wagner CAN SOLVE YOUR INDUSTRIAL BRAKE PROBLEMS



Type H brake for use where parking brake is not needed.



Type HM brake for use where parking brake is necessary.

for Your Present Requirements

If you have not yet installed Wagner Industrial Hydraulic Brakes, your problems of inadequate and inefficient braking can be solved by installing Type H (without parking brake) or Type HM (with parking brake). They are easy to order—and easy to install. When you order a Wagner industrial brake to replace one you now have, you receive a complete system which includes every part needed for its installation, and complete installation instructions.

Hydraulic brakes are now so universally applied to overhead cranes and other types of industrial machinery, that a repetition of their advantages over other types of brakes is hardly necessary today.

1. With Wagner industrial hydraulic brakes, the operator has *complete* control over the rate of deceleration—just as he has in his automobile.

2. If two brakes are involved, as in double-bridge braking, both brakes do an equal amount of work, and there isn't the strain on the machinery one encounters in unequalized mechanical brakes.

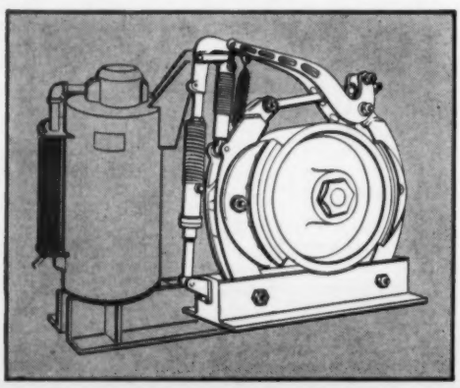
3. At all times, the brakes are actuated as soon as the operator steps on the brake pedal—no time loss, no energy loss.

4. The brakes are self-contained, involve no linkage, cables, rods, etc.; they are as simple in operation as the hydraulic brakes on your car.

5. In event of power failure, crane can be brought to stop as quickly as desired—hydraulic brakes are in no way affected.

for Modernizing the Wagner Brakes You now Have

If you have older Wagner Industrial Hydraulic Brakes, you will improve your braking system by modernizing your solenoid-type HM brakes, or you may have a Type H brake and find you now need the parking brake available on the improved Type HM brake. . . . Conversion kits are available for all HM brakes with solenoids (similar to diagram at the left), to replace the solenoids with the hydraulic-released spring-set cylinders. Also, kits are available to convert H-type brakes to HM brakes. Each kit is complete with all necessary parts and conversion instructions. Conversions are easily made.

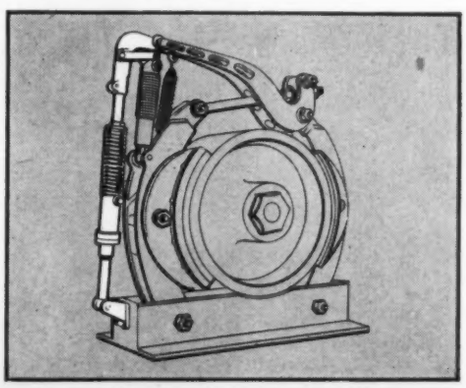


At left: Old-style solenoid brake can be readily converted to new-type HM brake.

At right: Type H brakes can be easily converted to type HM brakes.

Write for Complete Information

. . . write for descriptive data IU-34 for complete information on Wagner Industrial Brakes.



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ESTABLISHED 1891

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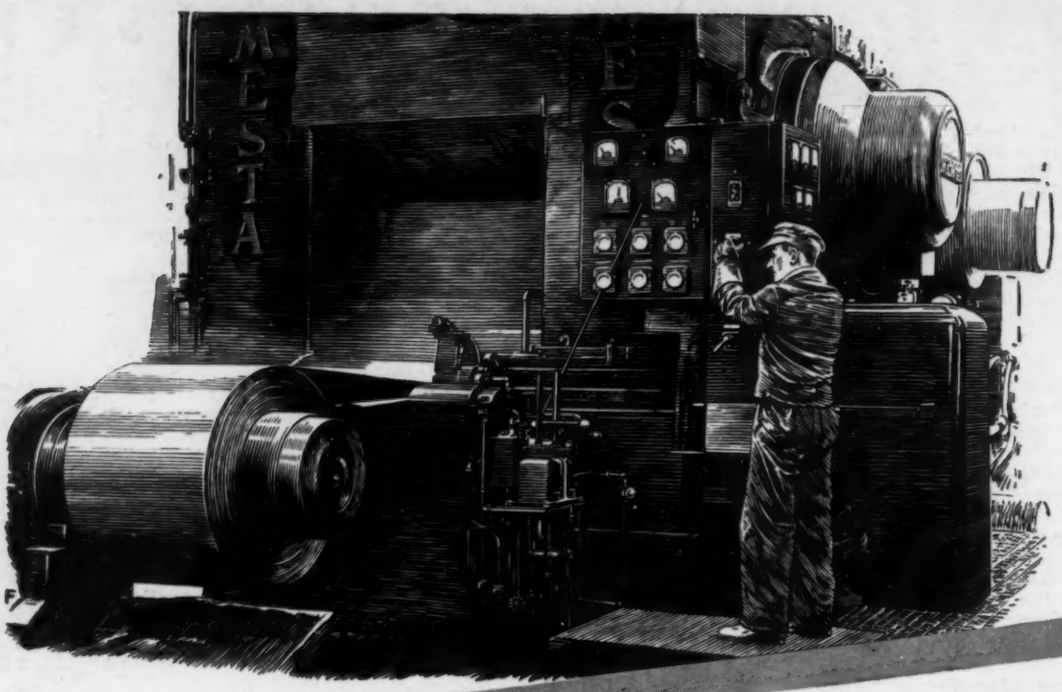
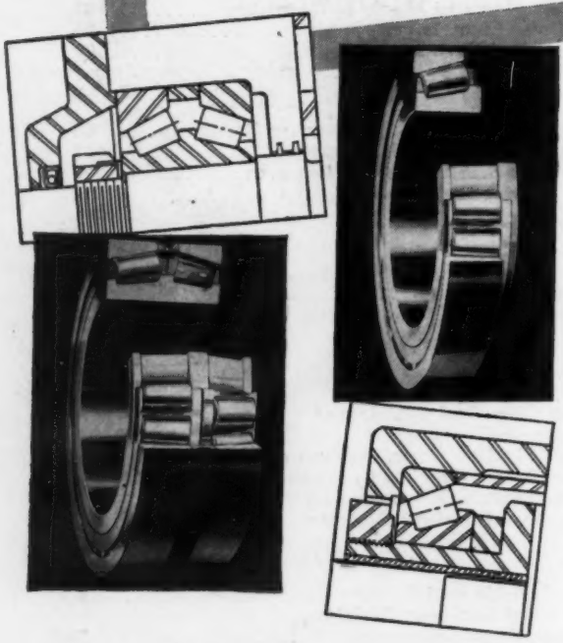


FOR FASTER COLD MILL REELS
...AND OTHER STEEL MILL EQUIPMENT



Mesta reel shown with Five Stand Tandem Cold Mill turns on one double-row and two single-row steep angle Torrington Tapered Roller Bearings. Capacity of bearings in pounds at 100 RPM: double-row-radial, 202,100; thrust, 155,200; single-row-radial, 114,500; thrust, 185,000. This is one of many steel mill applications where sturdy, efficient Torrington Bearings help speed production.

The reel of the cold mill you see above is one of the world's fastest. It "coils" 3,200 feet of strip per minute . . . and at required tension for final quality control. This means extreme radial and thrust loads on the reel . . . loads handled efficiently by one double-row and two single-row steep angle Torrington Tapered Roller Bearings.

In reels, screwdowns and edgers . . . on work rolls, back-up rolls, shears and drives . . . on table rolls, pinion stands and other steel mill equipment . . . Torrington Bearings provide efficient, economical, trouble-free *anti-friction operation.*

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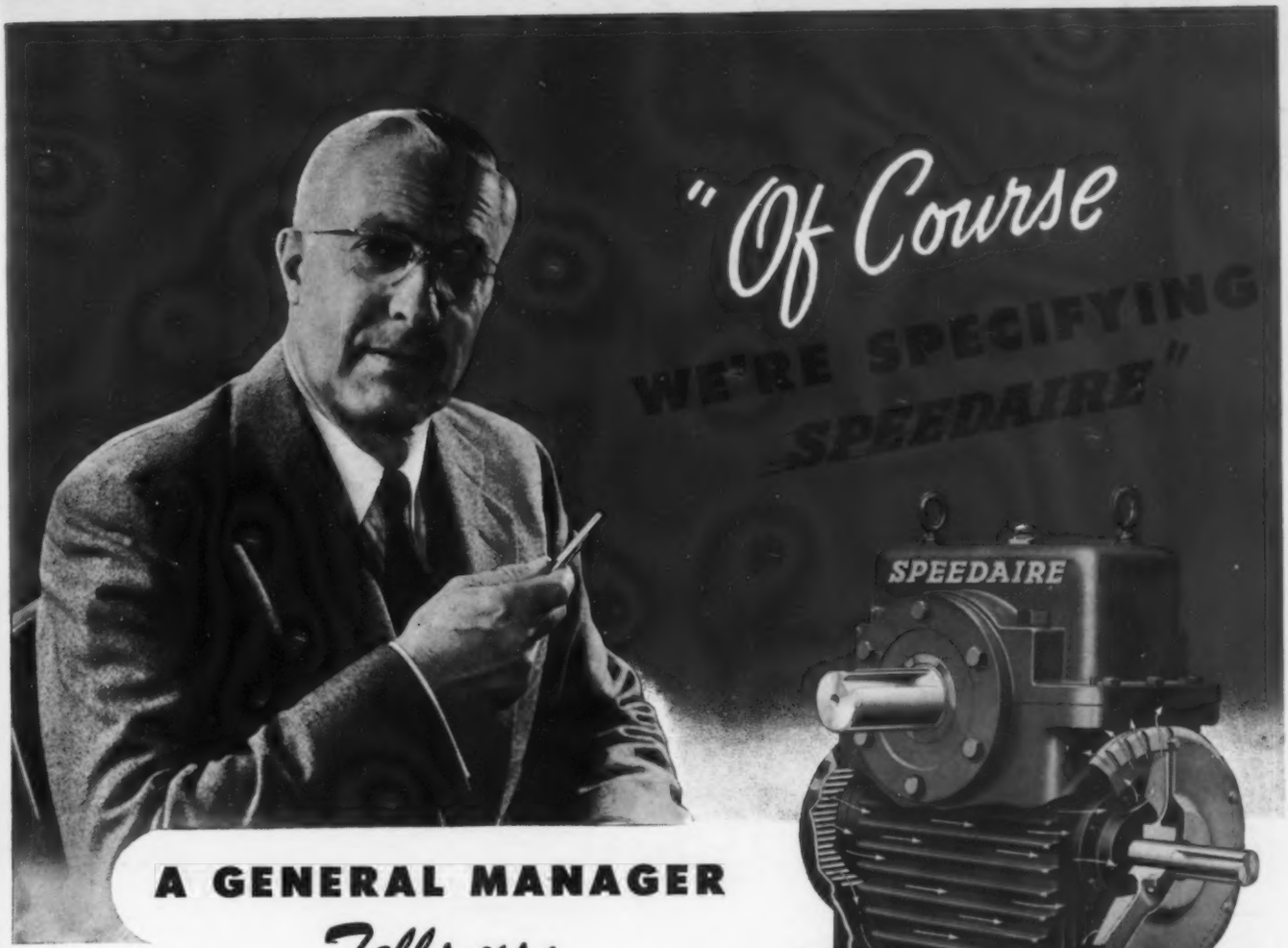
STRAIGHT ROLLER · TAPERED ROLLER · NEEDLE · BALL



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- Speedaire can be installed economically on many applications where other types have been used heretofore—giving you the advantages of a compact right-angle Drive.
- Speedaire is furnished in 6 standard sizes—from 3 to 95 H.P.

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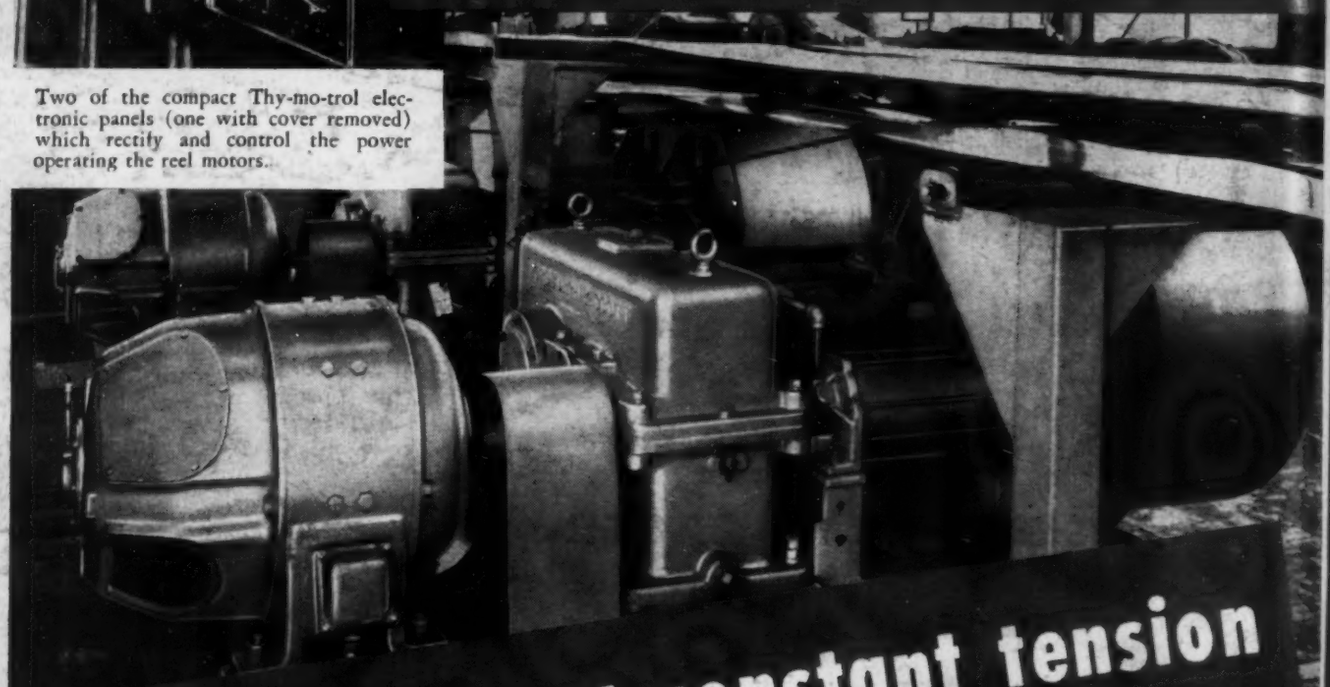
Cleveland
SPEEDAIRE *Worm Gear Reduction Units*
FAN COOLED

electronic self-adjusting drive

Two of the compact Thy-mo-trol electronic panels (one with cover removed) which rectify and control the power operating the reel motors.



...coils strip at constant tension

Thy-mo-trol d-c drive motors (400/1600 rpm) operate through speed reducers to provide the required reel speed. Motor field-control automatically reduces speed as coil diameter builds up, holding tension constant.

At Allegheny-Ludlum Steel Corp., West Leechburg, Pa., smooth, constant-tension coil winding is now possible on the delivery reels of strip-annealing furnaces. The mechanical problems of slip-clutch operation have been eliminated. Full flexibility to handle strip speeds from 3 to 12 fpm is provided. The drive adjusts itself to the speed changes required to allow for coil build-up from 16 to 40 inches in diameter.

OPERATES FROM A-C POWER

Operated from an a-c power source, 2-hp Thy-mo-trol drives on these small reels give the same stepless speed control and torque control that is obtained with larger d-c adjustable voltage systems on mill drives. The operator sets a tension-adjusting rheostat at the desired value, and this level is held throughout the wind-up of the coil.

WIDELY APPLIED

This is only one of the increasing number of Thy-mo-trol applications throughout the steel industry, where stepless speed control, constant acceleration, or constant speed under changing loads is required.

You buy Thy-mo-trol drive as a complete, co-ordinated set of equipment, including d-c motor, electronic panel, transformer, and control station. *Standard* drives can be obtained from 1/8 to 25 hp. G-E engineers will help you select and apply Thy-mo-trol drives, or explore their suitability for new types of jobs. To read the full story, ask for Bulletin GEA-4025. *General Electric Company, Schenectady 5, N. Y.*

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676-176-8030

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